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TEMPERATURE MEASUREMENTS IN SEEDED AIR AND NITROGEN PLASMAS

H. N. Olsen, G. Bedjai, and F. L. Kelly

Plasma Sciences Laboratories, Inc.

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NOTICES

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FOREWORD

The research reported herein was sponsored by the Arnold Engineering Development Center (AEDC) Air Force Systems Command (AFSC), under Program Element 6540216F, Project 4344, Task 434412.

The results of the research were obtained by Plasma Sciences Laboratories, Inc., Van Nuys, California 91406, under Contract F40600-68-C-0006. The research was performed during the period from June 15, 1968 to July 25, 1969 and the manuscript was submitted for publication on Sept. 15, 1969.

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The investigation was conducted under the direction of Dr. H. N. Olsen, serving as Principal Investigator with Mr. G. Bedjai assisting. Mr. F. L. Kelly, as a research associate, assisted with the experimental work which was carried out in the PWT of AEDC and in the laboratories of the contractor. The authors wish to acknowledge the excellent assistance and cooperation of the LORHO group in scheduling and operating the PWT 2-megawatt research arc heater at AEDC during the three series of tests made there.

This technical report has been reviewed and approved.

Vincent A. Rocco
1st Lt, USAF
Research Division
Directorate of Plans
and Technology

Harry L. Maynard
Colonel, USAF
Director of Plans
and Technology

ABSTRACT

Temperatures in the range of 2500 to 5000°K have been measured in the seeded air and nitrogen plasmas produced with the 2 megawatt arc heater at AEDC. Two spectral probes specially designed by the contractor were used for these measurements. Mass seed rates of potassium carbonate ranged from 0 to 1.88% by weight of potassium and power levels from 300 kw to 1000 kw. Temperatures determined from measured intensities of the continuous radiation and from atomic spectral lines of potassium were found in the seeded plasmas to agree satisfactorily with the static temperatures determined aerodynamically from an experimentally measured energy balance. Because of the strong dependence of intensity on temperature in the low range encountered, the observed intensity fluctuations in the jet resulted in less than a 10% change in temperature. Corrections of the seed lines for self-absorption brought the measured temperatures within 2% of those obtained from the continuum. The continuous radiation from unseeded air and nitrogen plasmas was measured to be about a factor of 15 higher than any existing theory predicts.

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NOMENCLATURE

A	Volume ratio of seed to total gas
A_T	Transition probability, sec^{-1}
B	Mass ratio of seed to total gas
ϵ	Emission coefficient, watts-cm^{-3}-sr^{-1} for lines, watts-cm^{-3}-sec-sr^{-1} for continuum
γ_{eff}	Effective ratio of specific heats
K	Upper rotational quantum number
λ	Wavelength, Å
N_i	Number density of i^{th} species of particles, cm^{-3}
N_I	Number density of total number of ionized particles, cm^{-3}
N_T	Number density of total number of particles, cm^{-3}
P_i	Partial pressure of i^{th} species of particles, atm
P_e	Partial pressure of electrons, atm
P_T	Total Pressure, atm
S_i	Equilibrium constant of i^{th} species or line strength
T	Temperature, °K
X	Position coordinate
Y	Intensity coordinate
Z_i	Partition function of i^{th} species

I. INTRODUCTION

The purpose of this investigation was to demonstrate the practical application of several methods developed under contract F-40600-67-C-0017 for measuring temperatures in potassium seeded nitrogen and air plasmas. Specially designed spectral probes were used to extend the applicability of the methods described in the technical report AEDC-TR-68-217 to the measurement of temperatures in the 2 megawatt research arc heater at AEDC.

Laboratory work performed under the above contract had previously shown that emission coefficients for atomic lines, molecular bands and the electron continuum can be measured in seeded nitrogen and air plasmas at temperatures above 6000°K; in the range of 5000°K to 6000°K the molecular band and continuum emission coefficients can be independently measured but at temperatures below 5000°K the strong continuum or spectral lines of the seeded material itself are the only species of radiation that can be measured. The correlations of measured emission coefficients with temperature were developed with the assumption of local thermodynamic equilibrium.

The preliminary work done with the facilities at Plasma Sciences Laboratories involved a stationary spectrograph and a moveable plasma source. Because of the larger size and stationary design of the AEDC ground test facilities, consideration was given to the use of moveable spectral probes to traverse the fixed plasma source. Two spectral probes have been built; one is a small spectrograph which can resolve both discrete spectral lines and small wavelength increments of continuous radiation, the other a simple continuum probe which requires no internal adjustments. A description of these spectral probes is given in Section II. The series of

tests made at AEDC on both nitrogen and air plasmas with and without seed are described in Section III. Some anomalies in the results of the tests performed at AEDC on unseeded plasmas made it necessary to perform some fundamental experiments at PSL on calibration types of pure nitrogen and air plasmas. This series of tests is described in Section IV. The conclusions drawn from this investigation and recommendations for its extension are discussed in Section V.

The computer programs developed for calculation of the plasma compositions needed to relate measured spectral intensities to temperature are described in the Appendix. A computer program which was developed under contract number F-33615-67-C1071-P002 for the Aerospace Research Laboratories at Wright Patterson Air Force Base was used for absorption correction of the experimental data obtained for potassium seed lines. No absorption correction was needed for the continuum.

II. SPECTRAL PROBES

Two diagnostic probes were developed for measuring temperatures in the AEDC seeded nitrogen and air plasma i.e., a light-weight transportable spectrograph for measuring seed lines with corrections for background continuum and a phototube-interference filter conbination for detecting the continuum alone. The guiding considerations in the design of these probes were the size of the necessarily fixed AEDC facility and the possible future need to make simultaneous measurements of the plasma at different angles should the plasma flame prove to be extremely asymmetrical. The spectral probes had to be light-weight and compact so that they could be translated relative to the plasma axis at a sufficiently rapid rate.

A. SPECTROGRAPH

A compact grating spectrograph was designed to have a first order dispersion of ~60Å/mm, a resolution of 0.3 Å and an optical speed of f/10.5. The physical dimensions are 4"x6-5/8"x13" and the total weight is less than 20 pounds. Wavelength adjustments are made with a standard machinist's micrometer with an effective dispersion of 4 Å per 1/1000 inch of displacement of the screw. Readout is made on an X-Y recorder using a 1P28 photomultiplier tube. The design of the spectrograph is shown schematically in Fig. 1. The lenses are identical and have a focal length of 283mm. The grating initially used was an inexpensive Wallace replica having approximately 630 lines per millimeter and a ruled area of approximately 25mm x 20mm, the shorter dimension being the length of the rulings. This was later replaced with a better quality Bausch and Lomb replica grating with

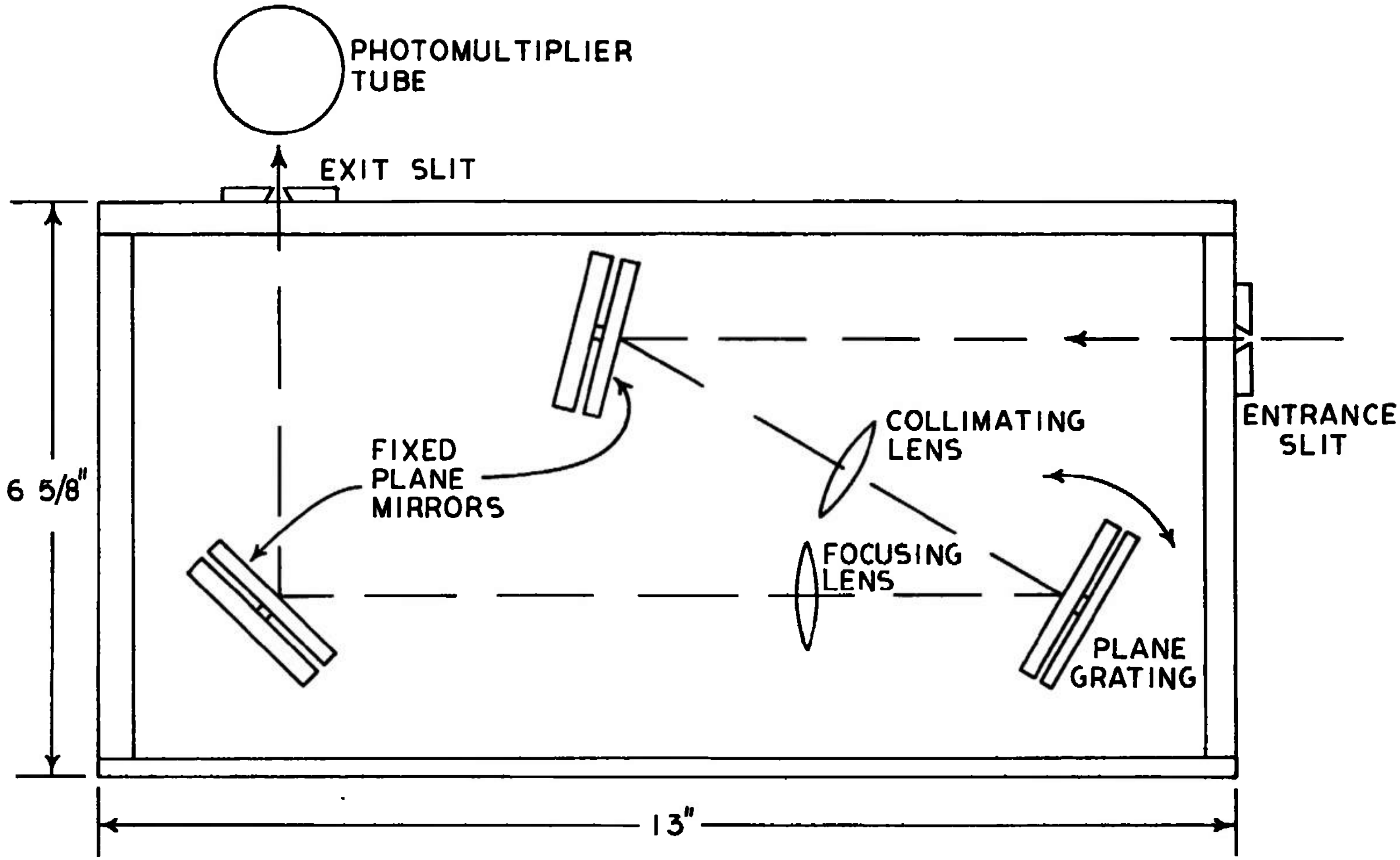

Fig. 1 Schematic Diagram of Small Grating Spectrograph

600 lines per millimeter. The aperture of the instrument is determined by the ruled area giving an effective speed of f/11. This is to be compared with a speed of f/9 for the PSL spectrograph. The reduced image used with the small spectrograph more than compensated for the slightly lower optical speed and permitted measurements at even lower intensity levels than were possible in the past.

Using a low pressure argon-mercury source the effective dispersion, $d\lambda/dx_{mic}$, was measured using the nine spectral lines given in Fig. 2. The average micrometer dispersion was used to draw the solid lines through the experimental points on Fig. 2 to serve as the dispersion curve for the instrument. From this measured dispersion, the measured arm length, R, and the lens focal length fl, the focal plane dispersion has been computed as

$$\frac{d\lambda}{dx_{f.p.}} = \frac{R}{2fl}\,\frac{d\lambda}{dx_{mic}}\,\cos\theta = 54.7\cos\theta\ \text{Å/mm}\ ,$$

where θ is the grating angle.

The focal plane dispersion was also determined from the measured spacing of the λ5461 and λ5770 lines to be 54.1 Å/mm.

The effective resolution of the instrument is demonstrated by the measured line shapes of the mercury yellow line pair shown in Fig. 3. This distribution was measured with 50μ entrance and exit slits. These two lines are separated by 21 Å which is the same as the spacing between the λ5832 potassium line and its nearest neighbor. The measured half width of the lines indicates a practical resolution of about 0.6 Å which is about 60% of the theoretical. There are, surprisingly, no problems with ruling ghosts even with the inexpensive grating. Even with the stronger λ5461 line the half width does not become much larger than that predicted by the grating indicating that ghosts may not be

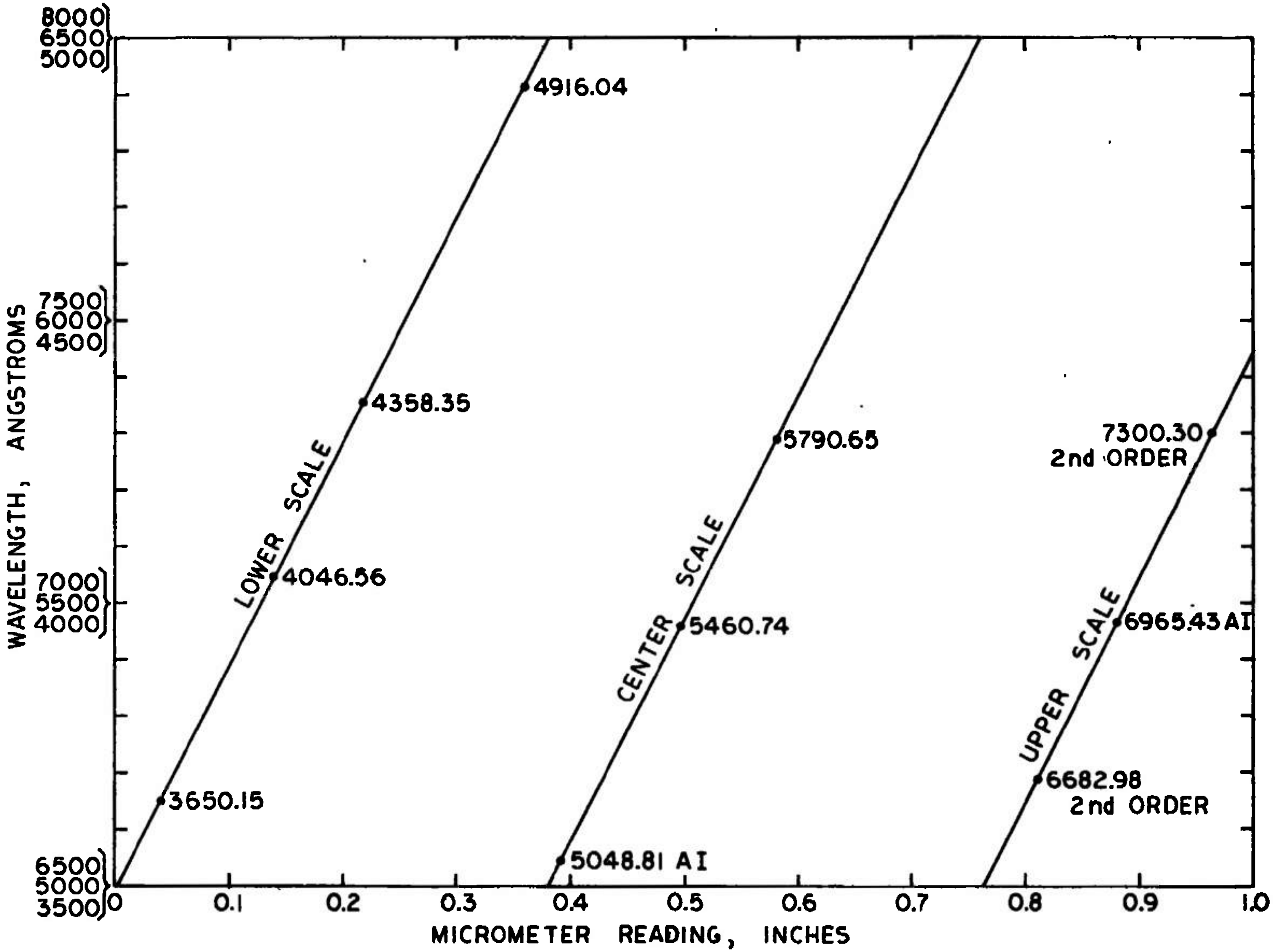

Fig. 2 Effective Dispersion Curve of Small Grating Spectrograph

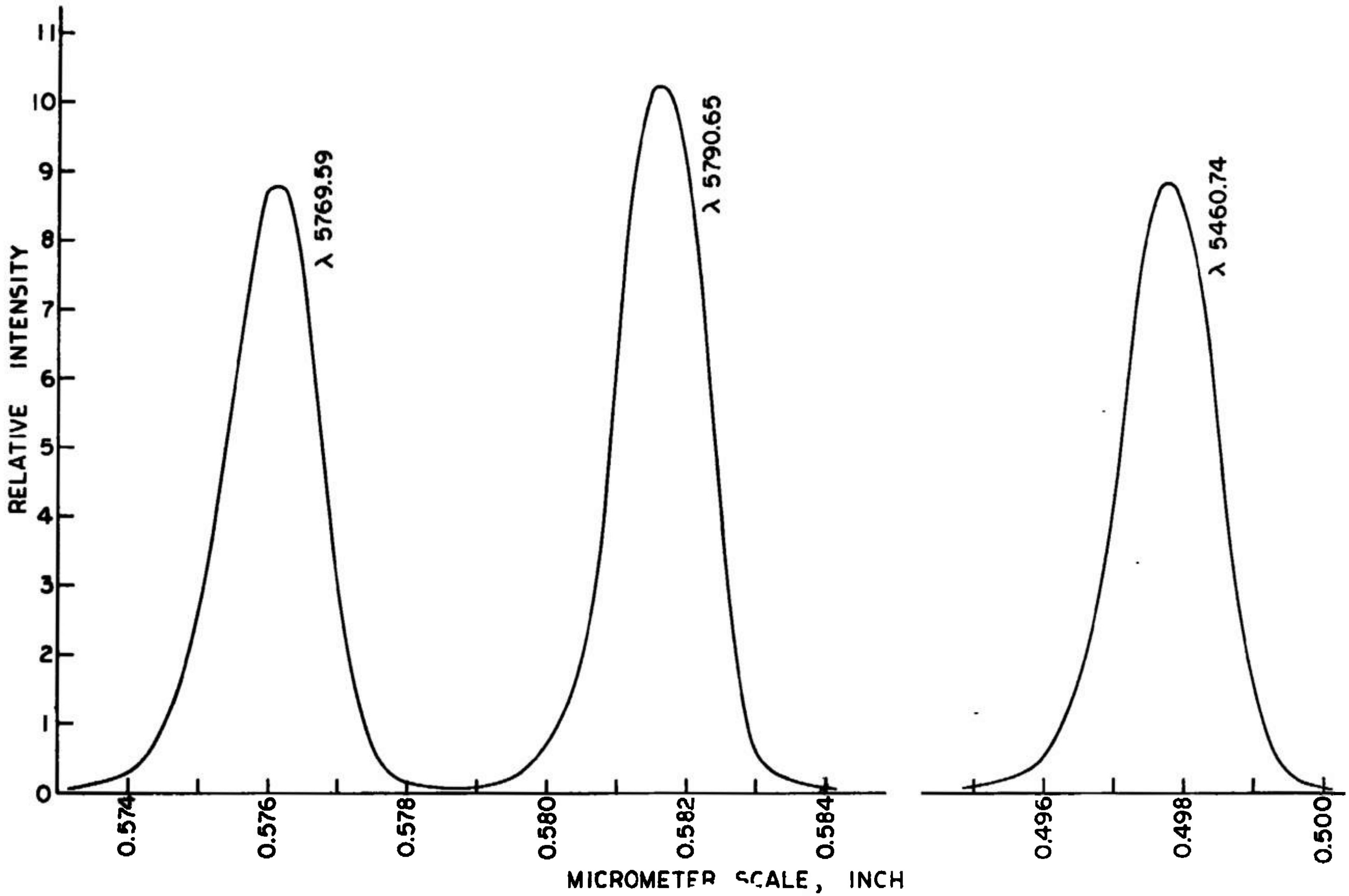

Fig. 3 Instrument Factor of Small Grating Spectrograph Using 50-μ Entrance and Exit Slits and a Sharp Line Mercury Source

effective. The poorer quality of the cheaper grating was clearly demonstrated by random variations throughout the background continuum. A Bausch and Lomb 25mm x 25mm replica grating having 600 lines per mm subsequently replaced the cheaper grating. At this time the optical alignment was considerably improved. The effective micrometer dispersion was checked with the mercury source to be 4011 ± 47 Å/in. From this measured dispersion and the measured arm length, the focal plane dispersion was computed to be $56.6 \cos\Theta$ Å/mm.

The measured dispersion using the $\lambda 5461$ and $\lambda 5790$ lines was 55.2Å/mm and using the $\lambda 4046$ and $\lambda 4358$ lines it was 55.7 Å/mm. With 50μ entrance and exit slits the half-width of the instrument factor for all lines was measured to be 4Å which is a significant improvement over the previous value of 6Å obtained with the inexpensive grating. The greatest improvement was in the uniformity of the background continuum.

B. CONTINUUM PROBE

An optical probe consisting of a collimating and focusing lens system, an interference filter and 1P28 photomultiplier tube was designed and constructed as shown schematically in Fig. 4 for measuring continuous radiation. The filter is mounted in parallel light with the source located at the focal point of the first lens which is 15 inches. The collimated beam through the filter is brought to a focus on the cathode of the photomultiplier tube by means of a five inch focal length lens. The optical speed of the detector is f/15. The interference filter has a half-width of 10Å with a center wavelength at 0° incident angle of $\lambda 5576$ Å. The transmission at the center wavelength is 54%.

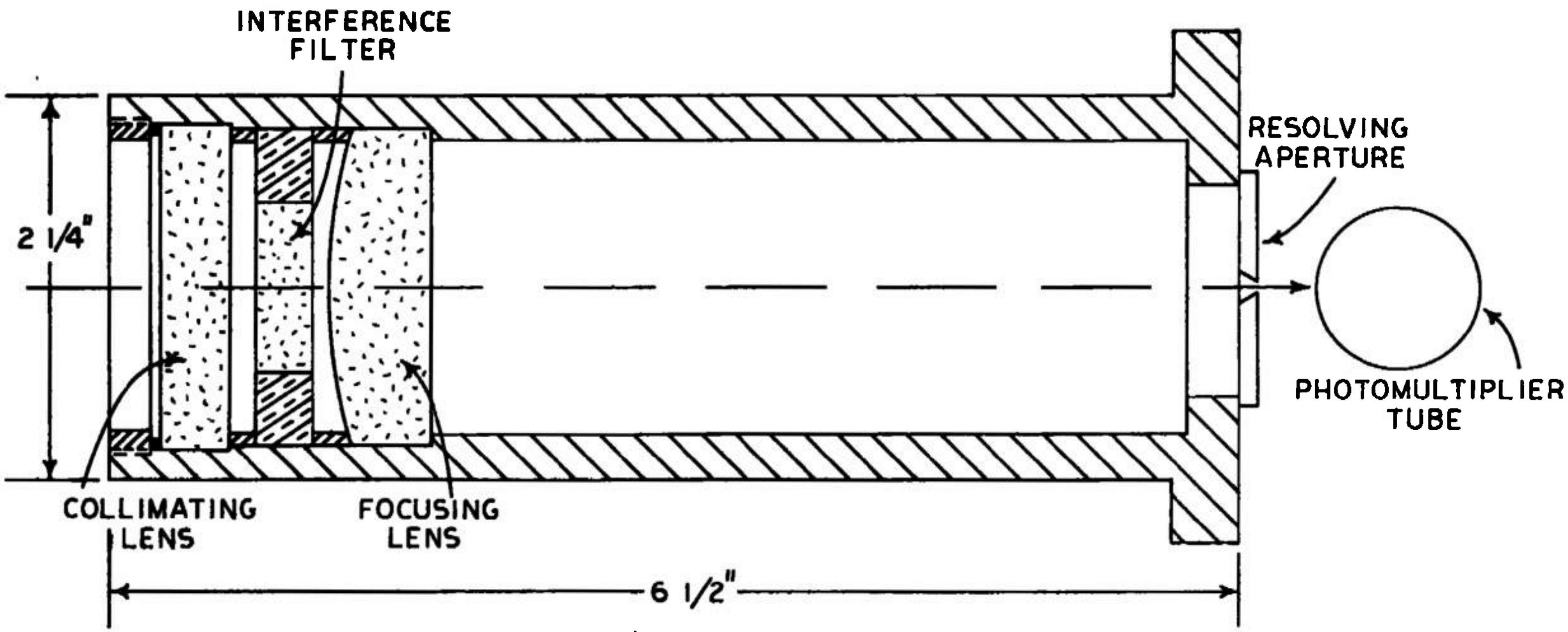

Fig. 4 Schematic Diagram of Continuum Probe

The transmission curve for the filter was checked by means of the calibration carbon arc and PSL spectrograph with the results shown in Fig. 5. The slight displacement of the distribution is probably due to deviations from normal incidence of the rays through the filter. The distribution was measured through the final optical system employed with the filter. The photomultiplier housing is designed to fit either the probe or the spectrograph. As a check, the probe was used to measure the continuum emitted by the free burning argon arc at PSL with results that are consistent with previous measurements.

C. CALIBRATIONS

Several calibrations were made of both probes prior to the tests at AEDC. An 8 amp tungsten ribbon lamp was calibrated at PSL against the carbon arc to have a true temperature in the range of 2800°K. This lamp, whose calibration curve is shown in Fig. 6, was used at AEDC to make direct absolute intensity calibrations. In addition the probes were calibrated directly with the carbon arc at PSL in the intensity range of 10^{-8} to 10^{-4} watt-cm^{-2}-sr^{-1} by attenuating the signal with calibrated neutral density filters. With a lens aperture of 5.1 mm, a 0.5 mm long 50μ entrance slit and a 280μ exit slit the detector system was found to have sufficient gain to measure light intensity levels down to 10^{-8} watt-cm^{-2}-sr^{-1}.

When calibrating measured intensities of spectral lines the effective exit slit width of the spectrograph must be known. With an exit slit of 280μ the width in wavelength was determined from the measured dispersion of the spectrograph to be 15.4 Å. To check the accuracy of the calibration based on the computed slit width the lateral intensity distribution of the λ6965 argon spectral line emitted by the 400 amp arc

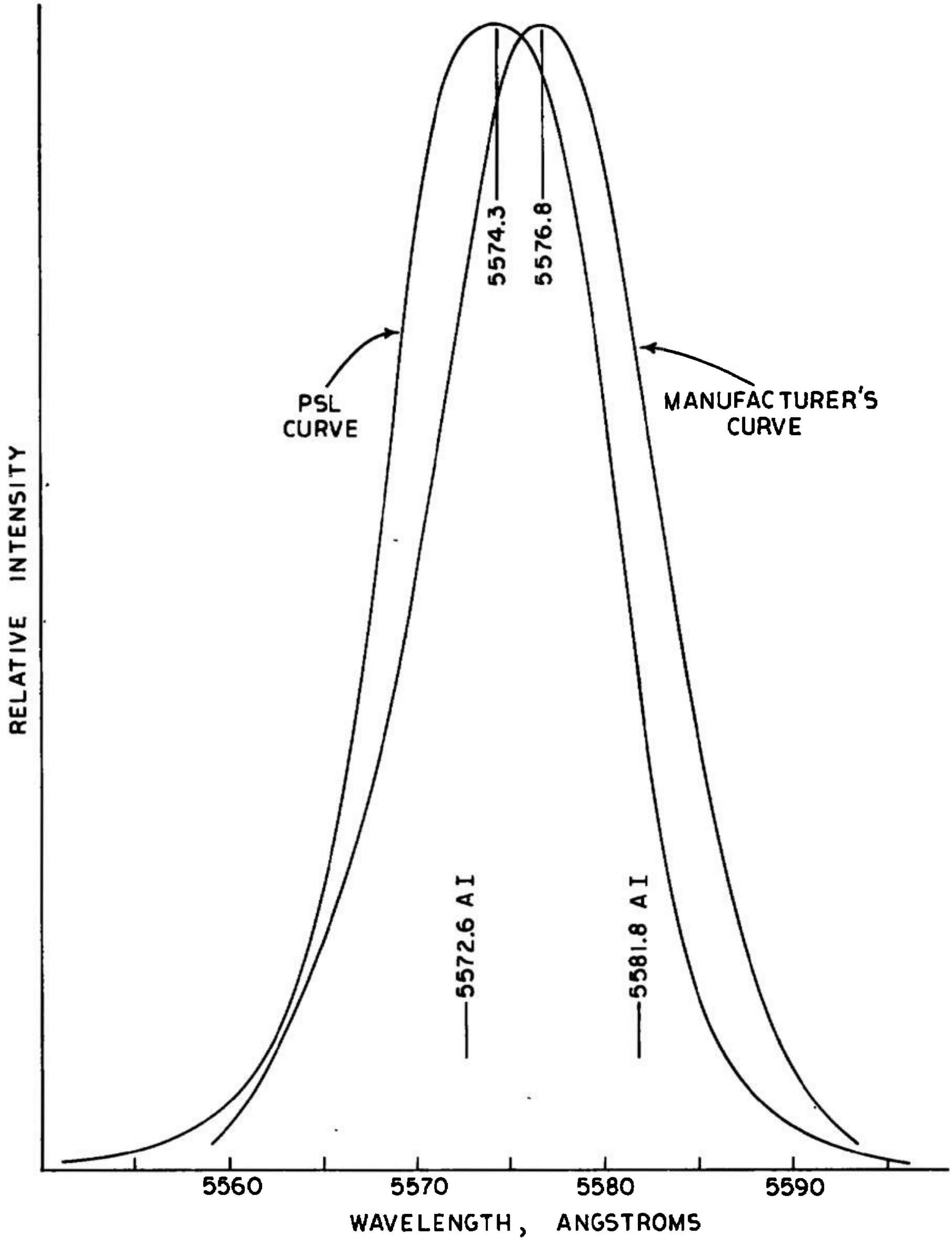

Fig. 5 Comparison of Measured Filter Response with That Supplied by the Manufacturer

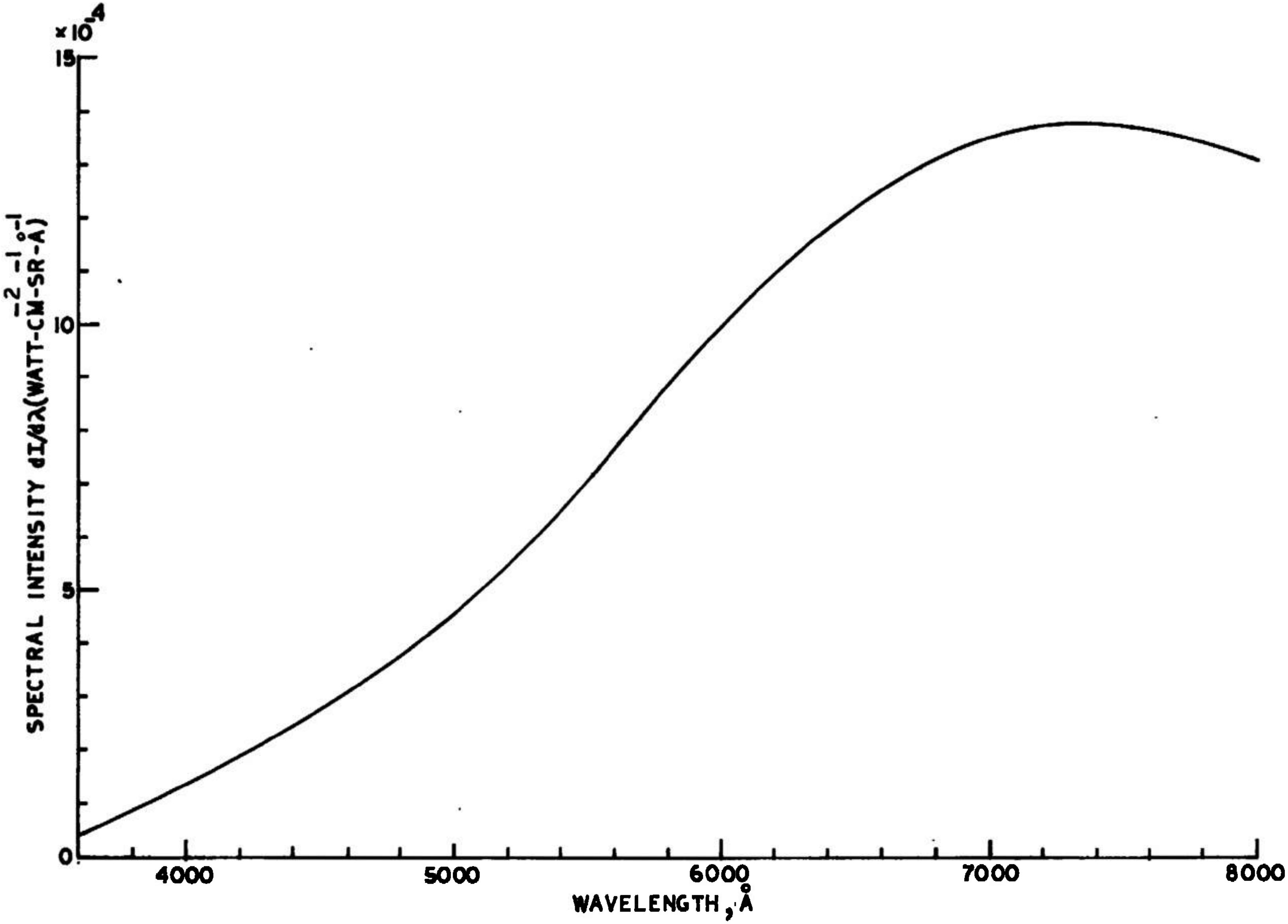

Fig. 6 Spectral Intensity Distribution for 8-amp Tungsten Ribbon Lamp

was measured with both the large (PSL) and small spectrographs. The excellent results of this comparison are shown in Fig. 7. Although the slit width does not enter into the continuum calibration a similar comparison was made between both spectrographs and the continuum probe with similar results.

D. TEMPERATURE DETERMINATIONS

Temperatures were determined from the properly calibrated radial distribution of the emission coefficients by comparison with the computed temperature distributions following the method described in detail in Ref. 1. The $\epsilon(T)$ curves for the specific seed ratios used here are presented in Fig. 8. Similar curves for other ratios can be plotted directly from the numerical data given in the Appendix.

The results of the first two series of tests described in the following Sections were converted to temperature by graphically reading the temperatures from the curves of Fig. 8 corresponding with the measured emission coefficient at the specified seed ratio. The data of the third series were converted to temperature directly within the MIPAP computer program which computes $\epsilon(T)$ and $\epsilon(r)$ with absorption corrections and curve fits to determine $T(r)$ by elimination of the emission coefficient as a common parameter.

The accuracy of the absolute line intensity as a measure of temperature results from the steepness of the rise of the emission coefficient with temperature in the temperature range of 2000 to 5000°K which is considered here. It is for this reason that errors of the order of 10% in computed number densities, available transition probabilities and uniformity of seed ratios within the plasma are not serious when the desired results are plasma temperatures in the above specified range.

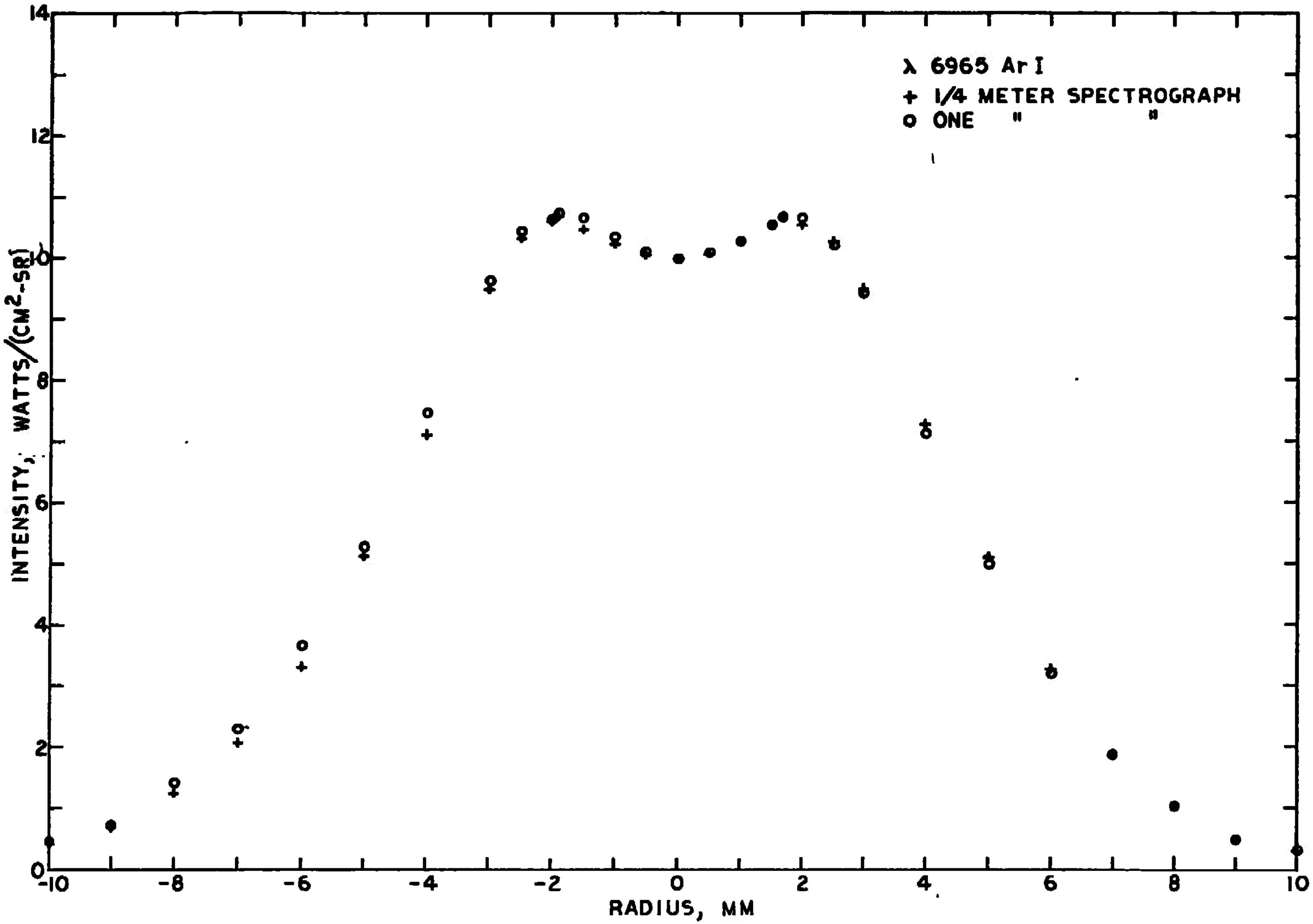

Fig. 7 Absolute Intensity Distribution Measured with Two Different Spectrographs and Phototubes

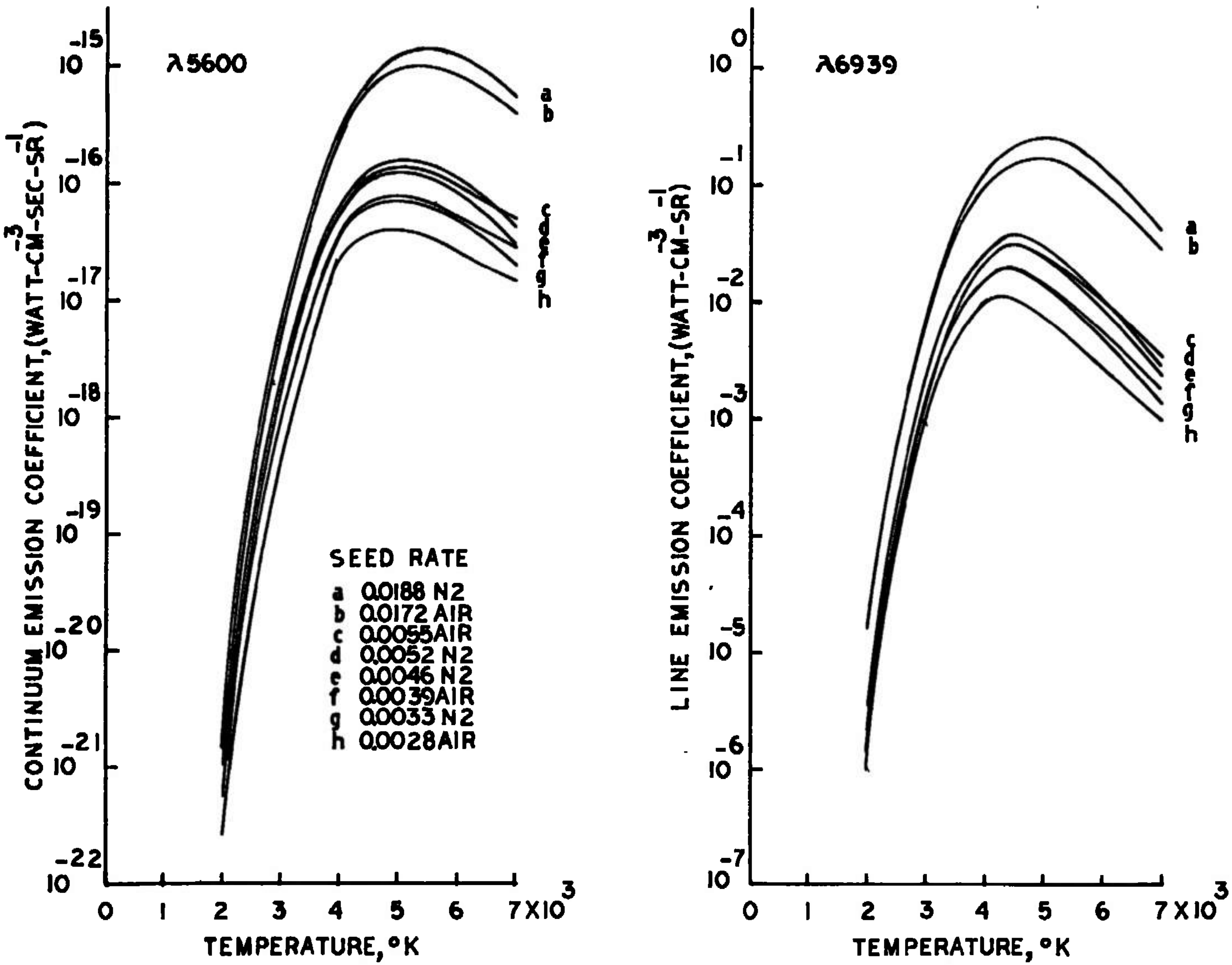

Fig. 8 Computed Temperature Dependence of Continuum and an Atomic Line of Potassium for Seeded Air and Nitrogen Plasmas at 1-atm Pressure

E. TRANSPORT TABLE

A transport table was designed and constructed to translate either the spectrograph and its lens system or the continuum probe relative to the symmetry axis of the plasma source. With this table the optical axis, which defines the spectral probe, can be translated in a periodic manner over a total displacement of 1.9 inches. The period of travel can be set at 30 sec, 15 sec or 7.5 sec by means of interchangeable gears. The lateral displacement is translated linearly into an x-axis potential by means of a linear potentiometer coupled directly to the moveable table.

For the tests made at AEDC a support designed to mount the transport table directly above the 2 megawatt AEDC arc heater was constructed. With this support the spectral probe was directed downward with horizontal translation in the plane normal to the jet axis as shown in Fig. 9. The same system was used to support either the spectrograph or the continuum probe and associated lens systems. The spectral probes are shown mounted on the transport table in their operating positions relative to the AEDC arc heater in Fig. 10.

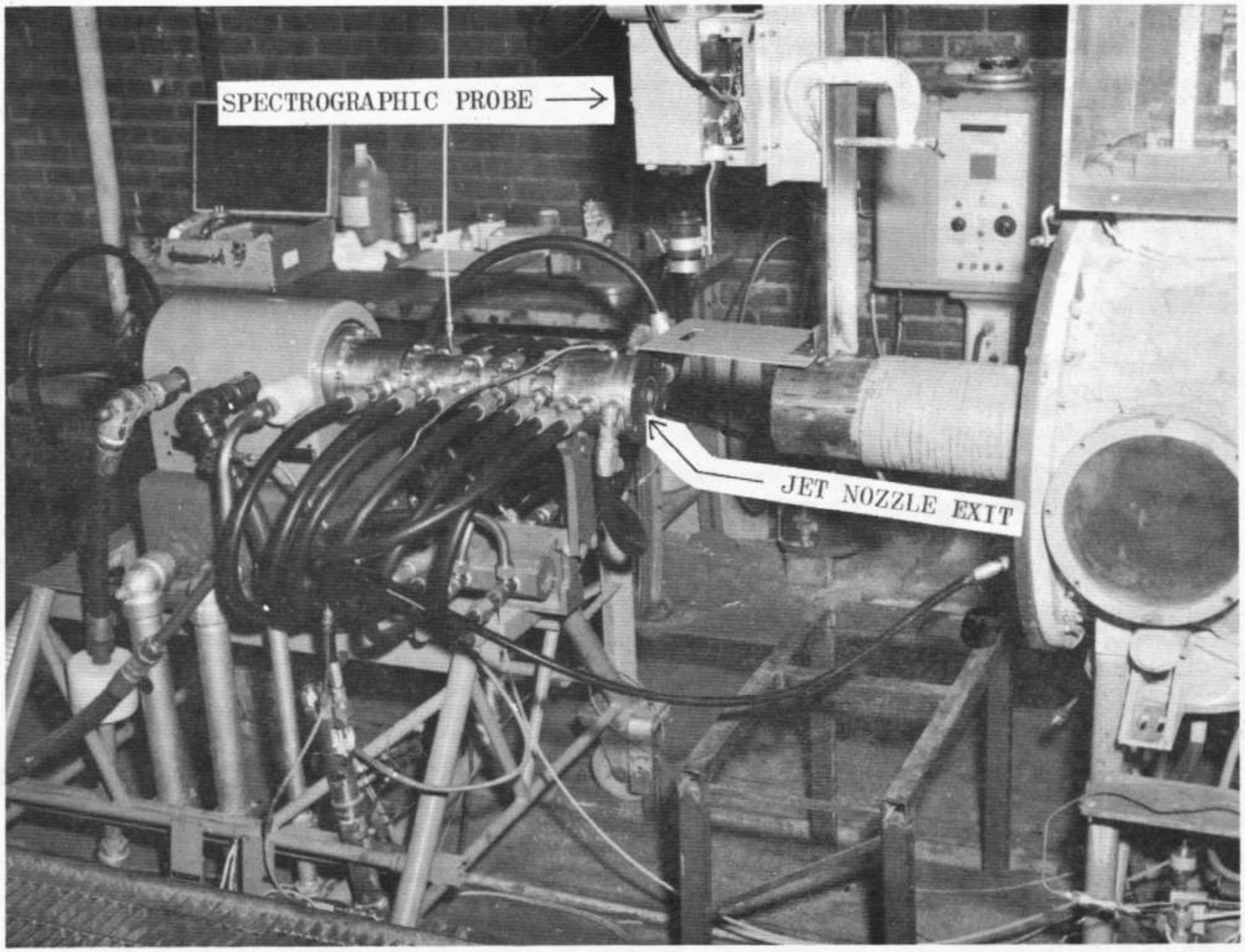

Fig. 9 AEDC 2-megawatt Arc Heater with Spectrographic Probe Mounted in Operating Position above the Jet Center Line

SPECTROGRAPHIC PROBE CONTINUUM PROBE

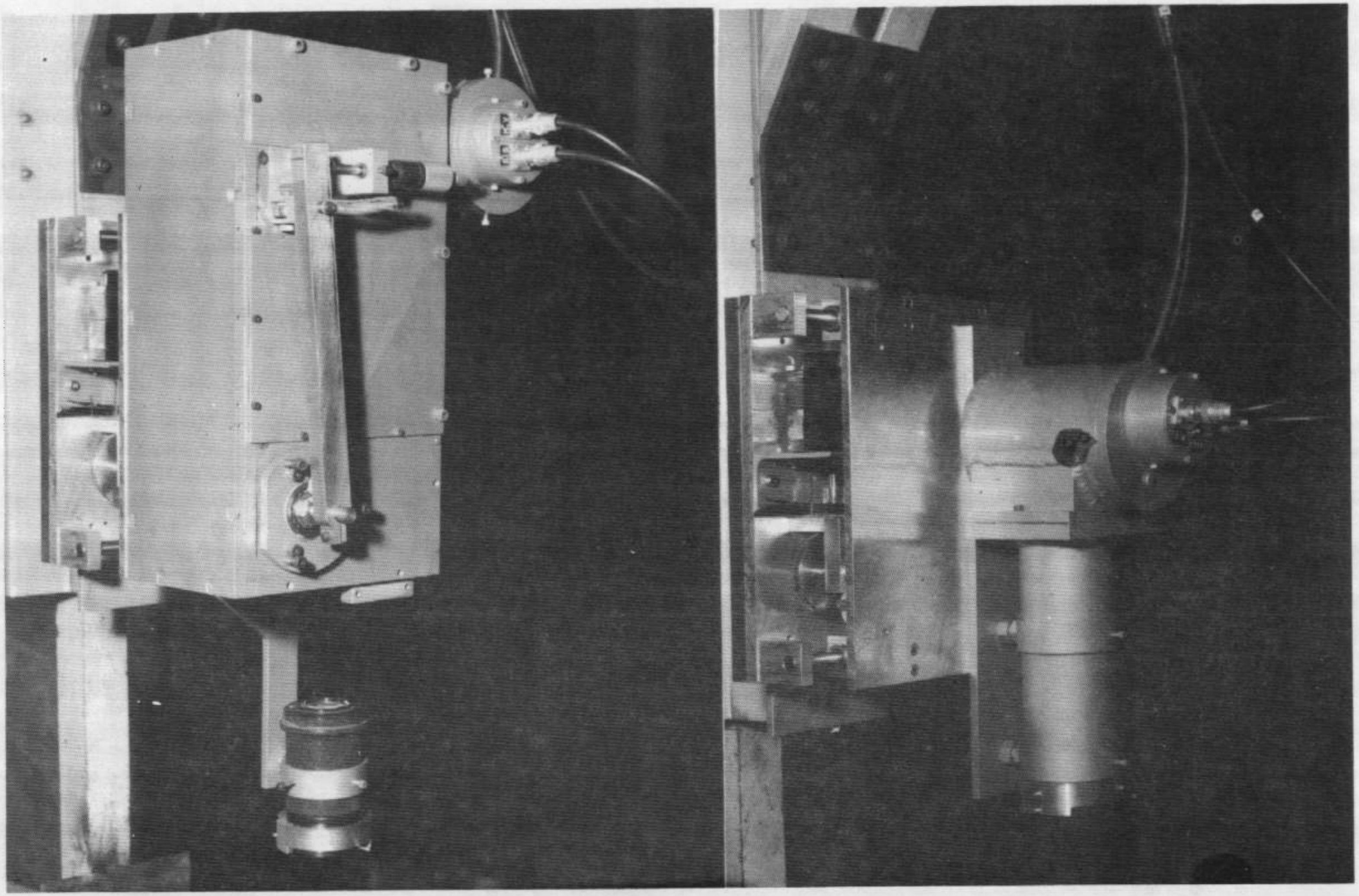

Fig. 10 Spectral Probes Including Transport Table Shown Mounted on Support Beam in Operating Position

III. EXPERIMENTATION AT AEDC

Three series of tests were made on the PWT 2 megawatt arc heater facility at AEDC. The first series emphasized experimental measurements on seeded nitrogen plasmas though some unseeded reference runs were made. The second series of tests was concentrated on similar runs of seeded air plasmas. The third series was needed to gather further information on the effect of seed rate and power level on the accuracy of the methods for determining temperatures.

A. SERIES I: NITROGEN PLASMA

During this series twenty-five runs of the AEDC arc facility were made while recording lateral distributions of the molecular band and continuum intensities for the pure nitrogen jet, and seed atomic line and continuum intensities for the seeded nitrogen jet exhausting into the atmosphere.

1. Experimental Measurements

Spectral measurements were made with both probes which could be accurately moved with respect to the jet in lateral and axial positions. Photoelectric detection was used with the output displayed on an X-Y recorder. Absolute intensity calibrations were made in situ by means of the calibrated tungsten ribbon lamp. The probe calibrations were later checked at PSL by comparison with an Euler carbon arc and found to be reproducible to $\pm 5\%$.

The operating conditions for each run of the heater, which ranged from 850 to 1000 kw total power input, are given in Table I. These data were provided by the ARO engineering group responsible for the operation of the facility. In order to correlate the heater operating conditions with spectroscopic results reported here the PSL data book numbers have been added under the "remarks" section of the table.

TABLE I
SUMMARY OF TEST DATA
SPECTROSCOPIC TEMPERATURE MEASUREMENT
PWT 2-MEGAWATT ARC FACILITY
PART 1

TUNNEL ENTRY 11-18-68 TO 11-22-68

		1	2	3	4	5	6	7	8	9	10	11	12	13 14 15
		V_A (volt) ±10	I_A (amp) ±2	P_A kw ±10	P_G kw ±10	$\dot{m}$ lb/sec ±0.002	h_t kcal/kg	p_t atm ±0.05	T_t °K ±100	Seed Rate wt %K $\frac{\text{wt K}}{\text{wt}_{N_2}+\text{wt K}}$	Probe Used	Dist from Nozzle Exit Inches	PSL DATA BOOK NUMBER	REMARKS
	RUN													
11-18-68	1	1520	625	950	553	0.203	1434	3.78	4682	0	Spectroscopic	1/4	6-27-1	
11-19-68	2	1560	605	944	561	0.212	1391	3.76	4574	0	Spectroscopic	1/4	6-28-1→5	
	3	1580	600	948	557	0.212	1381	3.86	4550	0		1/4	6-28-6→9	
	4	1610	600	966	574	0.212	1423	3.93	4656	0		1/4	6-28-10→14	
	5	1610	595	958	567	0.212	1399	3.93	4596	0	Continuum	1/4	6-28-15	
	6	1620	599	970	572	0.212	1416	3.98	4641	0		1/8	6-28-16	
	7	1615	600	969	571	0.212	1414	3.93	4618	0		3/8	6-28-17	
	8	1630	600	978	574	0.212	1423	4.03	4661	0		1/2	6-28-18	
	9	1620	545	883	477	0.212	1884	3.93	3992	0		5/8	6-28-19→23	Heat loss data indicates power is higher than measured.
11-20-68	10	1410	608	857	478	0.210	1199	3.86	4040	0.46	Spectroscopic	1/4	6-30-1→3	
	11	1430	608	869	488	0.215	1195	3.93	4029	0.46		1/4	6-30-4→6	
	12	1450	608	882	500	0.220	1195	3.95	4029	0.46		1/4	6-30-7→9	
	13	1450	608	882	499	0.220	1193	4.06	4020	0.46		1/4		Water leak developed in arc heater during run. 6-30-10→14
	14	1440	608	876	496	0.220	1188	4.25	4008	0.46		1/4	6-30-15→19	
	15	1440	610	878	501	0.215	1226	4.00	4120	0.46		1/4	6-30-20,21	
	16	1480	610	903	522	0.220	1252	4.10	4198	0.46		1/4	6-30-24→27	
11-21-68	17	1440	611	880	503	0.216	1235	4.07	4146	0.46	Continuum	1/4	6-32-1→3	
	18	1480	605	895	511	0.218	1235	3.84	4146	0		1/2	6-32-4	
	19	1490	605	901	512	0.218	1238	3.84	4153	0		1/2		Residual seed cleaned out of arc heater 6-32-5
	20	1440	605	871	497	0.216	1214	4.01	4082	0.46		1/2	6-32-6,7	
	21	1450	608	882	509	0.216	1241	4.06	4163	0.46		3/4	6-32-8	
	22	1450	608	882	508	0.216	1238	4.01	4153	0.46		1	6-32-9	
	23	1465	600	879	504	0.216	1229	4.06	4128	0.46		1-1/4	6-32-10	
	24a	1440	607	874	496	0.216	1211	4.01	4073	0.46		1/4	6-32-11	
	24b	1460	690	1007	552	0.216	1346	4.25	4460	0.46		1/4	6-32-12,13	

V_A - Total arc volts
I_A - Total arc current
P_A - V_A I_A
P_G - P_A - Losses
$\dot{m}$ - Total wt flow - N_2 + Seed
h_t - Total enthalpy
p_t - Total pressure
p_{NE} - Nozzle exit pressure
T - Static Temp at nozzle exit
A^* - Throat area - 0.370 in.^{2}

To demonstrate the magnitude of fluctuations and the degree of asymmetry encountered in the spectral intensity measurements, one lateral distribution of the continuum emitted by the seeded N_2 plasma has been reproduced in Fig. 11. The fluctuations and asymmetry of this example are far more severe than those generally observed. Because of the relatively slow scanning speed the fluctuations can represent either spatial or temporal variations.

Although the horizontal axis represents a linear spatial distribution, because of the eccentric type of drive of the transport table, the time required for each centimeter of displacement on the chart increases with distance from the center of the chart. This relationship is expressed as

$$\frac{\Delta t}{\Delta x} = 1/(2\pi f\sqrt{R^2-x^2}) \quad \text{SEC/CHART-CM}$$

where f is the speed in rev/sec of the eccentric drive of radius R. For x measured in chart-cm the radius must be expressed in the same units. The conversion factor for the data reported here is 8.87 chart-cm/cm and R=2.38 cm. With these constants and a drive speed of one rev/60sec, $\Delta t/\Delta x = 9.55/(444-x^2)^{\frac{1}{2}}$ sec/chart-cm. On the axis of symmetry this gives a value of .45sec/chart-cm and at the edge of the plasma (x=12chart-cm) the corresponding number is .55 sec/chart-cm. The rise or fall times of the fluctuations shown in Fig. 11 are of the order of 0.5 cm or less. Assuming these are entirely temporal they represent times of the order of 0.2 sec. The largest fluctuation on Fig. 11 occured at the rate of 27 cm/sec which is about a factor of 2 slower than the limit of the recorder pen. It appears, therefore, that the observed fluctuations are real and not smoothed by the recorder system. There may, however, be much more rapid

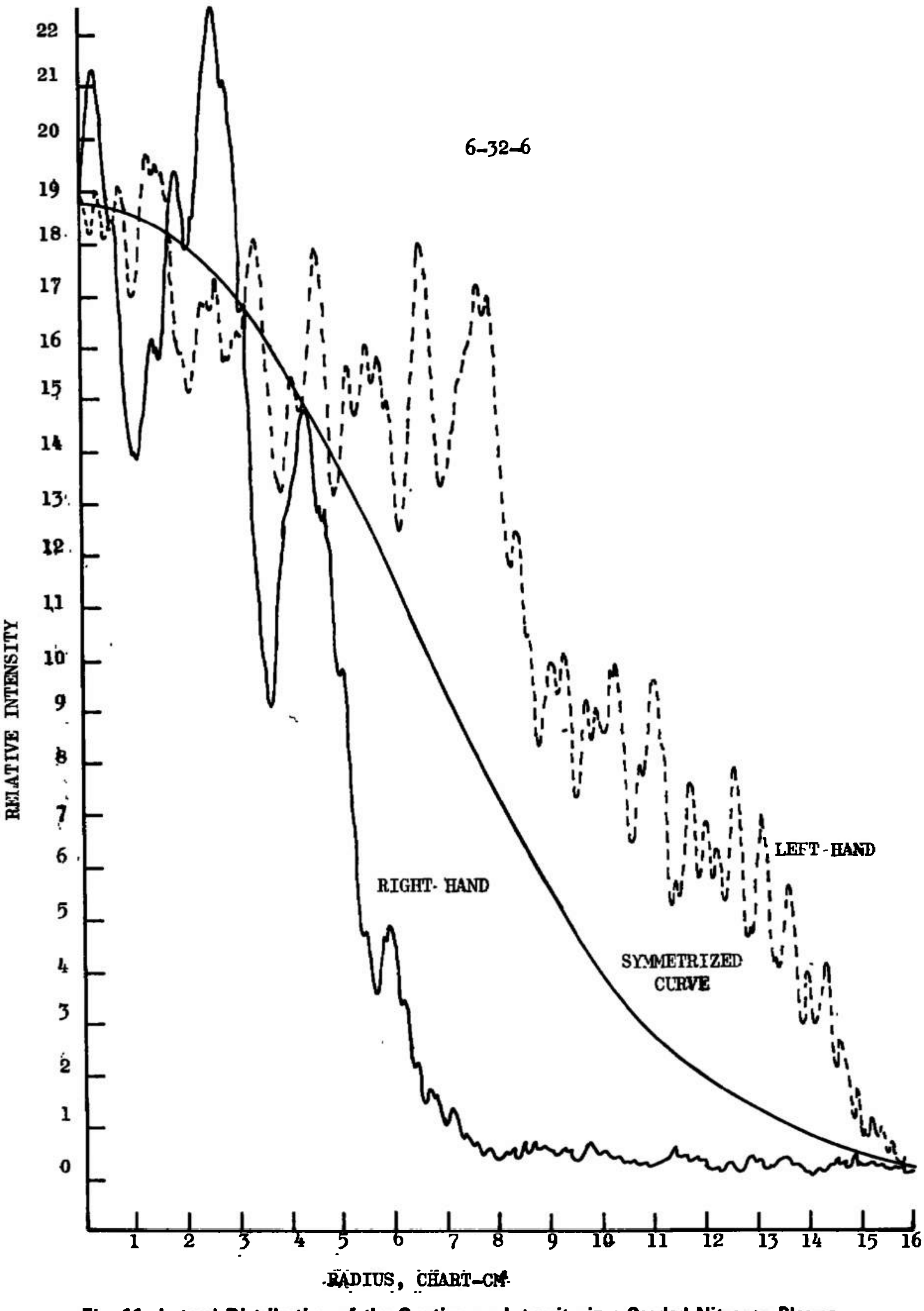

Fig. 11 Lateral Distribution of the Continuum Intensity in a Seeded Nitrogen Plasma

transients which are smoothed out entirely by the recorder and therefore are not indicated. These would be observed with any oscilloscopic read-out system.

In order to obtain temperatures from the measured intensity it was first necessary to invert the lateral intensities to emission coefficients. Since only a single lateral distribution was recorded for each run, the inversion can be performed only for an assumed symmetrical source. Using both halves of the lateral distribution obtained by folding about the best average axis, two extreme radial temperature distributions were obtained for the data of Fig. 11. These are compared in Fig. 12 with the symmetrical distribution determined from the averaged intensity distribution as shown on Fig. 11. In spite of the extreme asymmetry the averaged temperatures agree quite well with those obtained from distributions which exhibit much less severe asymmetry. Compare for example the results of curve 6-30-10 (see Fig. 15) which showed fluctuations of less than 9% (peak to peak) of the intensity at the radius of the half-value and the asymmetry was completely negligible throughout the trace.

2. Experimental Results

Radial distributions of the emission coefficient for the λ5576 continuum measured $\frac{1}{4}$ inch from the exit of the pure nitrogen jet are shown in Fig. 13 along with similar data for the λ3914 molecular band. The absolute values for the continuum emission coefficient are more than two orders of magnitude higher than those measured in the PSL subsonic nitrogen jet for temperatures in the range of 3500°K. According to an experimental ϵ vs T curve given by Morris, Krey and Garrison[2] for the continuum of the pure nitrogen plasma the electron temperatures corresponding with the measured continuum

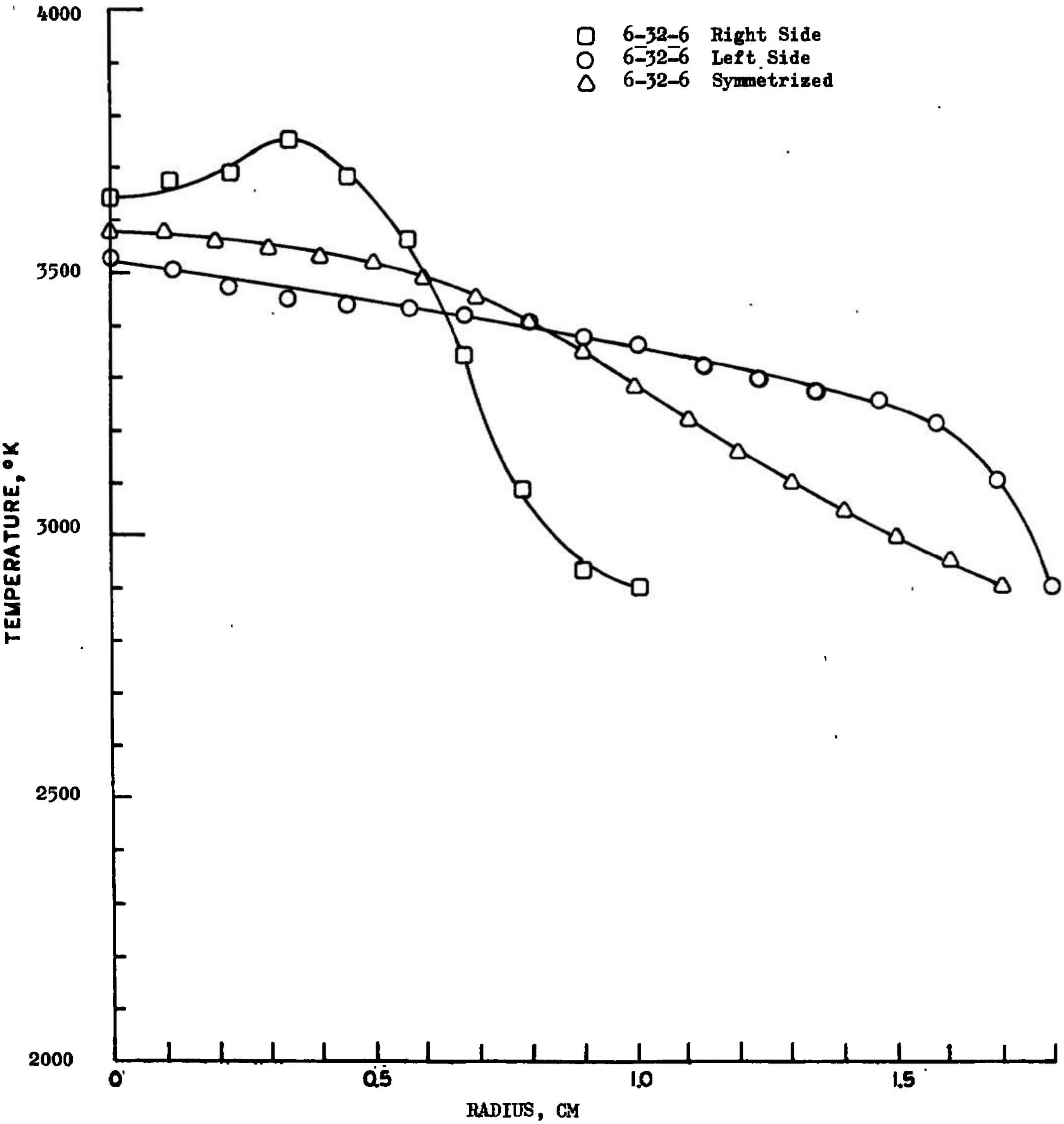

Fig. 12 Temperature Determined from Left-Hand, Right-Hand, and Symmetrized Distributions of Fig. 11 for the Seeded Nitrogen Plasma

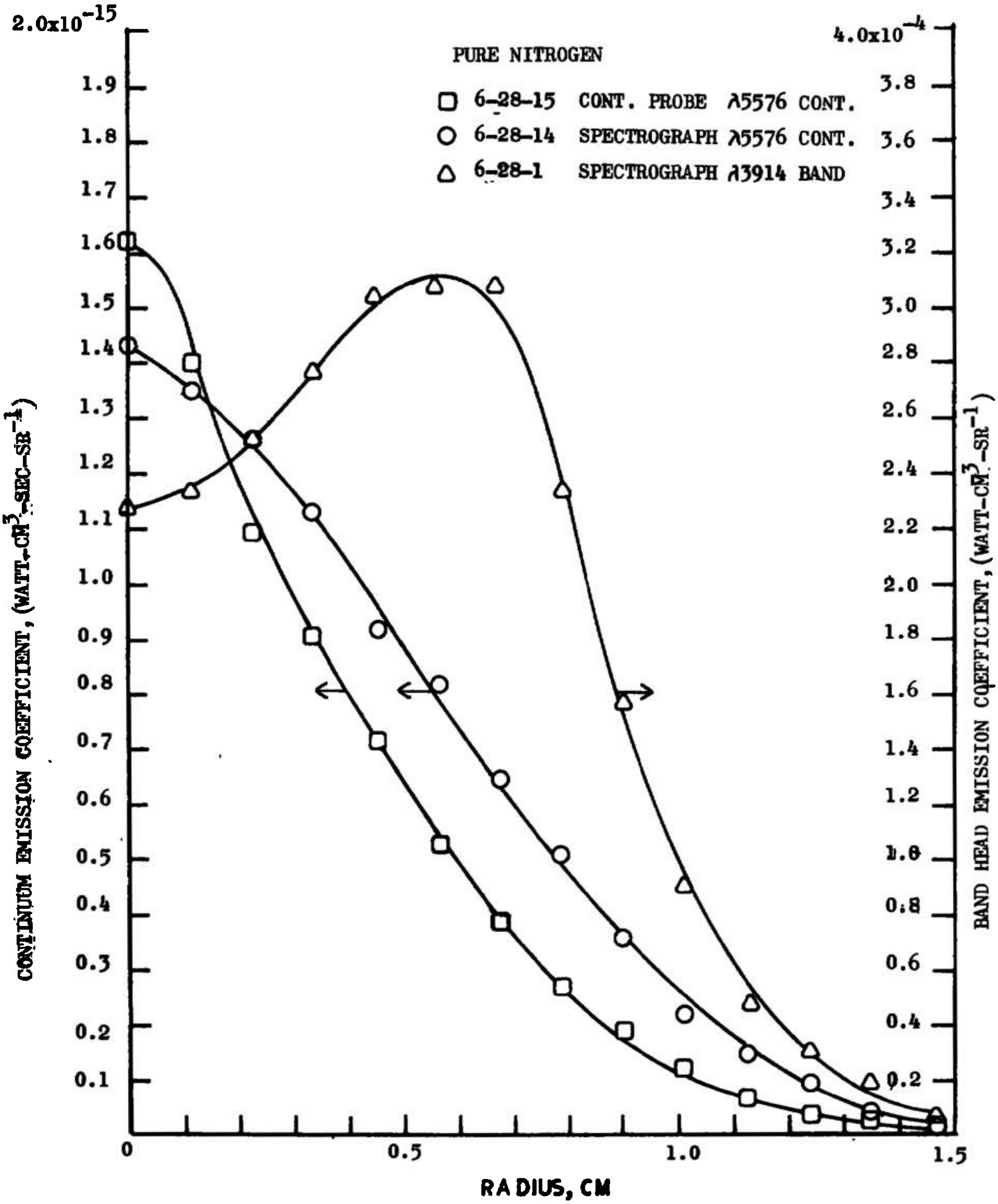

Fig. 13 Emission Coefficient versus Radius for the λ5576 Continuum and the λ3914 Band Head in a Pure Nitrogen Plasma

emitted by the AEDC jet should be in the range of 9000°K. The temperature distribution for the AEDC supersonic nitrogen jet as determined from the absolute intensity of the ion molecular band is $\sim$ 5000°K as shown in Fig. 14. At this temperature the continuum intensity according to Ref. 2 should be below 10^{-17}. In previous measurements on the PSL jet the continuum at 6000°K was measured to be 8×10^{-17} watt-cm^{-3}-sec-sr^{-1} where the temperature was determined from the λ3914 band head. Whereas the measured continuum always increased with the addition of seed to the subsonic jet at PSL it was, strangely enough, observed to decrease by about two orders of magnitude with the addition of seed to the supersonic jet at AEDC with the results for the seeded jet being quite consistent with the equilibrium results obtained at PSL.

The discrepancy in measured continuum for the unseeded jets might be interpreted as an indication of nonequilibrium in the supersonic stream. The higher temperature indicated by the continuum might be explained as an elevation of the electron temperature above the heavy particle temperature. Such a nonequilibrium could explain the presence of atomic nitrogen lines previously observed by the ARO research group in the spectrum of the AEDC nitrogen jet at temperatures where, in equilibrium, such lines should not be expected to be observed above the background continuum.

The results of measurements of intensities of potassium seed lines and the continuum on the seeded nitrogen jet give much more realistic temperature profiles than for the pure nitrogen jet. Radial distributions of the emission coefficients of three different potassium lines and of the continuum measured at the same distance from the nozzle by means of the spectrograph and the continuum probe are given in Fig. 15.

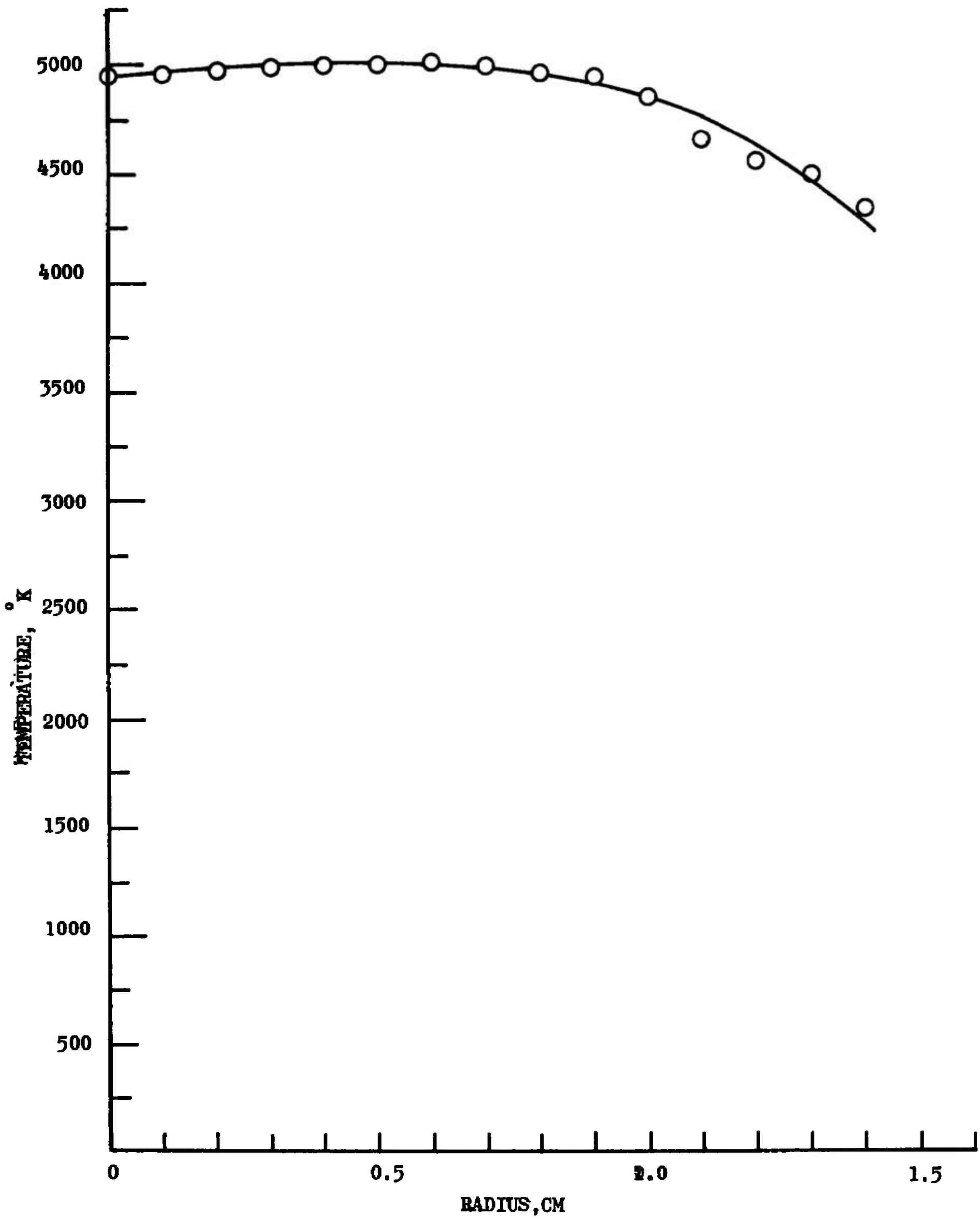

Fig. 14 Radial Temperature Distribution Determined for the Pure Nitrogen Plasma from the λ3914 Emission Coefficient of Fig. 13

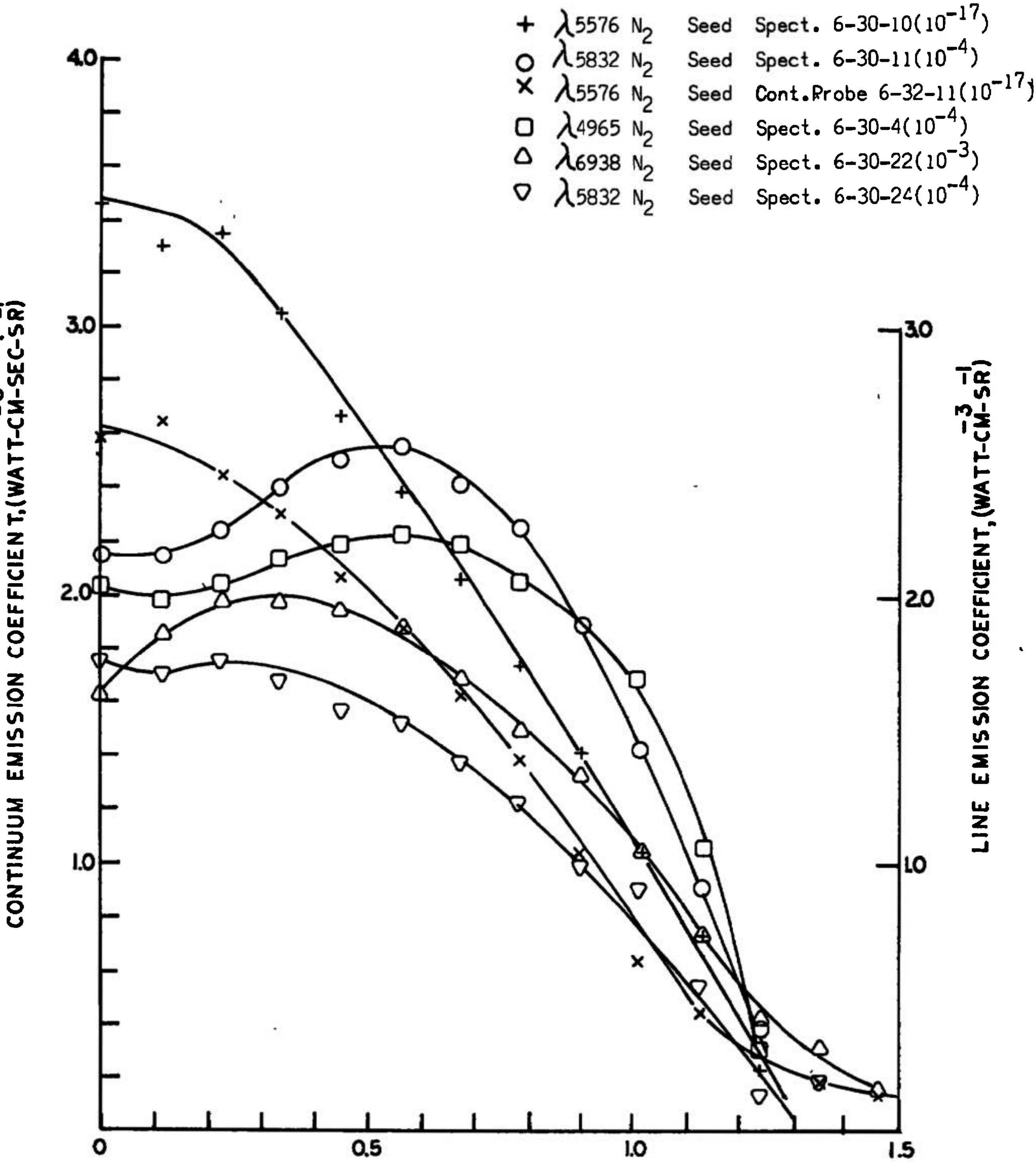

Fig. 15 Emission Coefficient versus Radius for Three Lines of Potassium and the λ5576 Continuum Emitted from Seeded Nitrogen Plasma

The corresponding radial temperature distributions are given in Fig. 16 where the solid curve represents the arithmetic average of the six temperatures and the dashed curve is for absorption correction of one line. The jet velocity, total enthalpy and total temperature have been determined as a function of radius, assuming M=1.65, using Drellishak's[3] tables for static enthalpy, γ_{eff}, and the sonic velocity. The results are given in Table II where the total temperatures are less than 300°K higher than the mean values given in Table I.

Finally temperatures as a function of position along the seeded jet axis have been obtained from the measured radial distributions of the continuum emission coefficient given in Fig. 17. The results are shown in Fig. 18 where it can be seen that the axis temperature first increases with position from the nozzle and then decreases; the maximum appears to coincide with the location of the first diamond of the shock pattern in the jet. To further demonstrate the geometry of the jet, contours of equal continuum emission coefficients are plotted for the symmetrized jet in Fig. 19.

B. SERIES II. AIR PLASMA

During this second series of AEDC tests twenty-three runs of the 2 megawatt arc heater were made while recording lateral intensity distributions of the continuum for the unseeded nitrogen and air jets and the continuum plus atomic seed lines for the seeded air jet. A summary of the test data for these experiments is given in Table III.

1. Experimental Measurements

During this series of tests only the spectrograph was used as a probe since it was found to give the same results

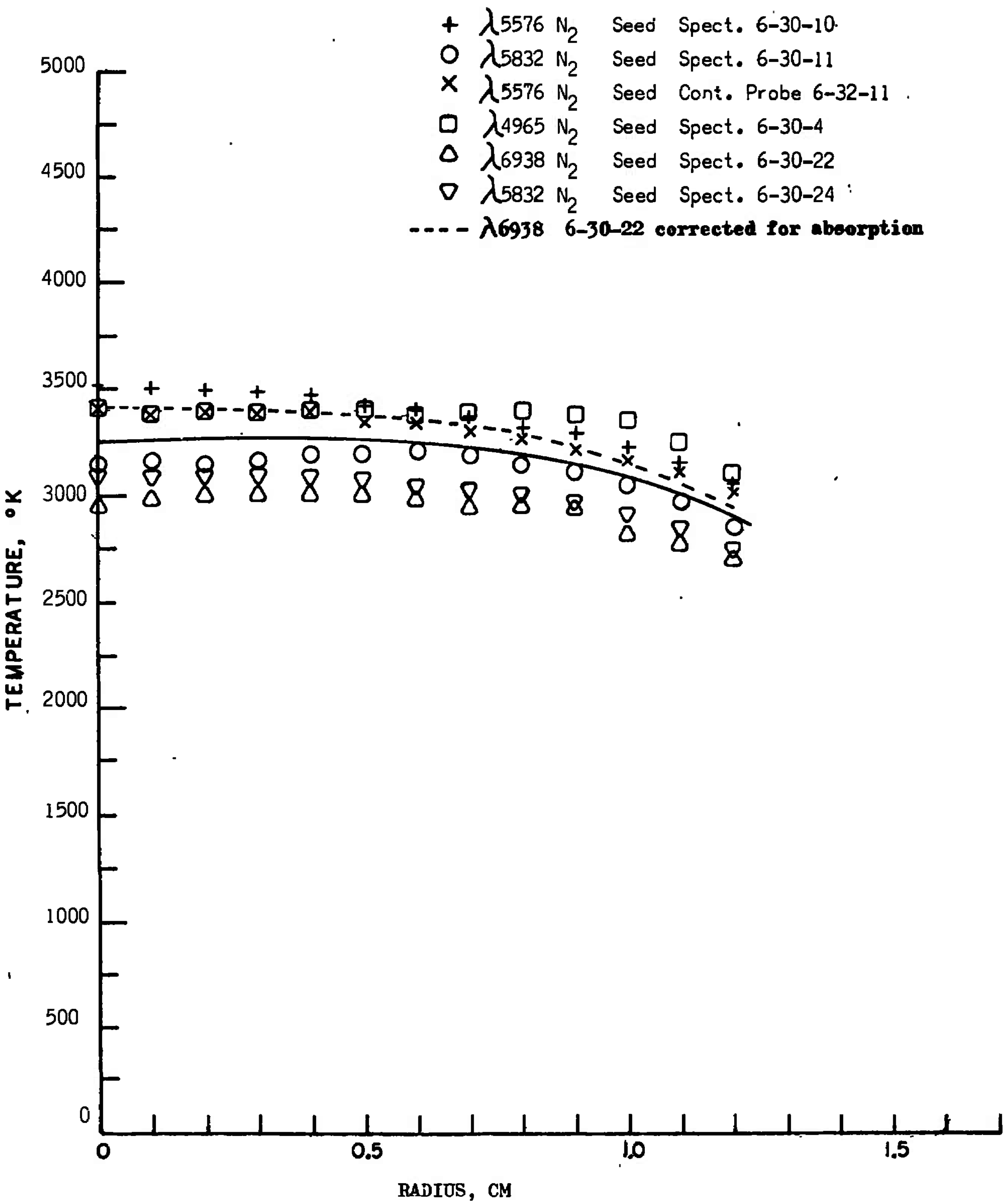

Fig. 16 Temperatures Determined from the Distributions in Fig. 15

Table II. Total temperature calculated from spectroscopically measured static temperatures assuming M=1.65.

R Radius cm	T Temperature °K	Hs* Static Enthalpy kc/kg	γ_{eff}*	a* Speed of Sound m/sec	v Velocity m/sec	H_{total} Total Enthalpy kc/kg	T_t Total Temperature °K
0	3260	947	1.29	1115	1840	1351	4430
0.5	3250	944	1.29	1114	1838	1347	4421
0.6	3232	938	1.29	1110	1832	1339	4402
0.7	3205	929	1.29	1106	1825	1326	4369
0.8	3180	922	1.29	1102	1818	1313	4344
0.9	3143	910	1.29	1096	1808	1300	4303
1.0	3088	892	1.29	1087	1794	1276	4239
1.1	3020	871	1.29	1075	1774	1247	4158
1.2	2913	837	1.29	1056	1742	1199	4024

* See ref. 3

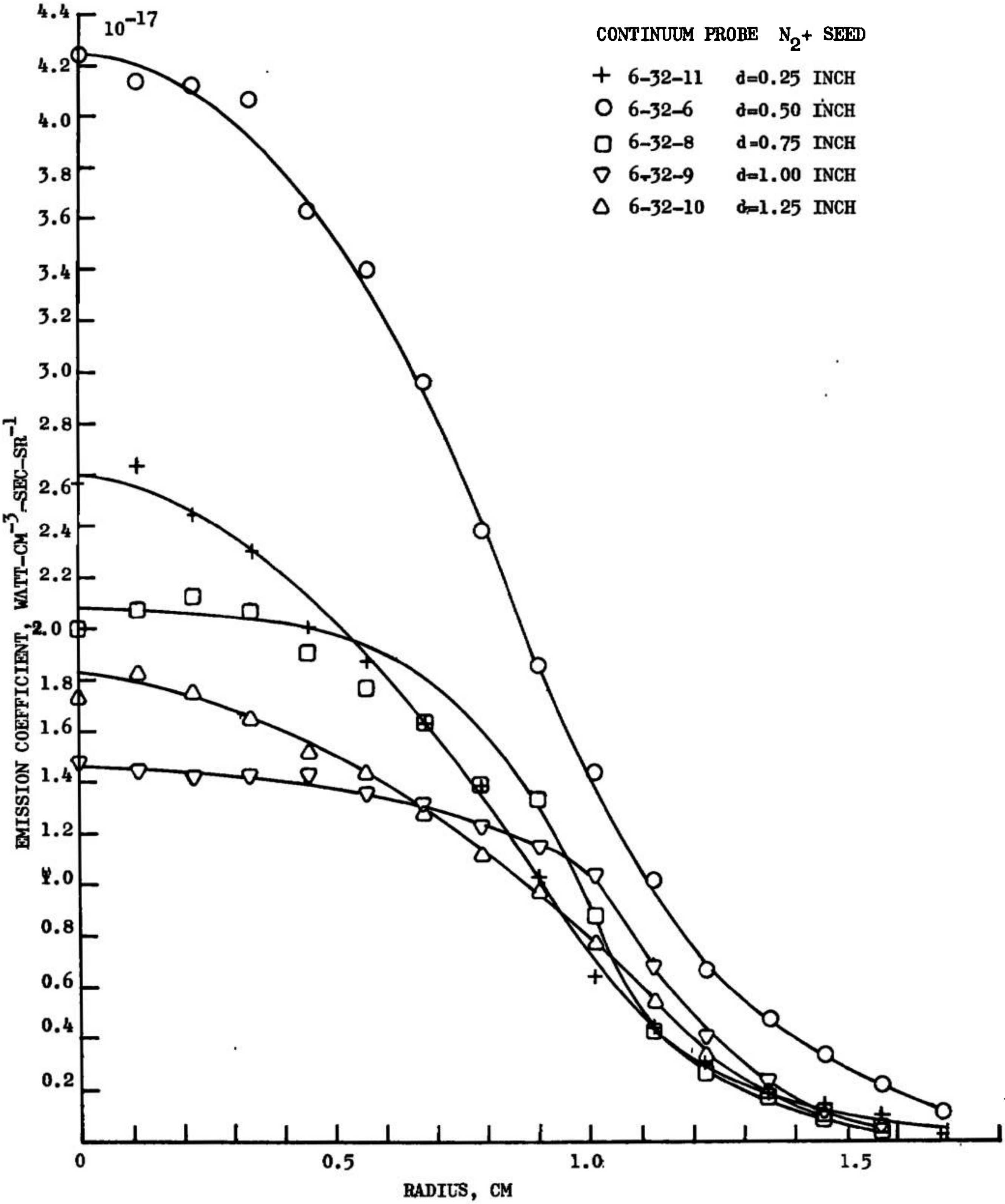

Fig. 17 Emission Coefficient versus Radius for the λ5576 Continuum for Five Different Axial Positions

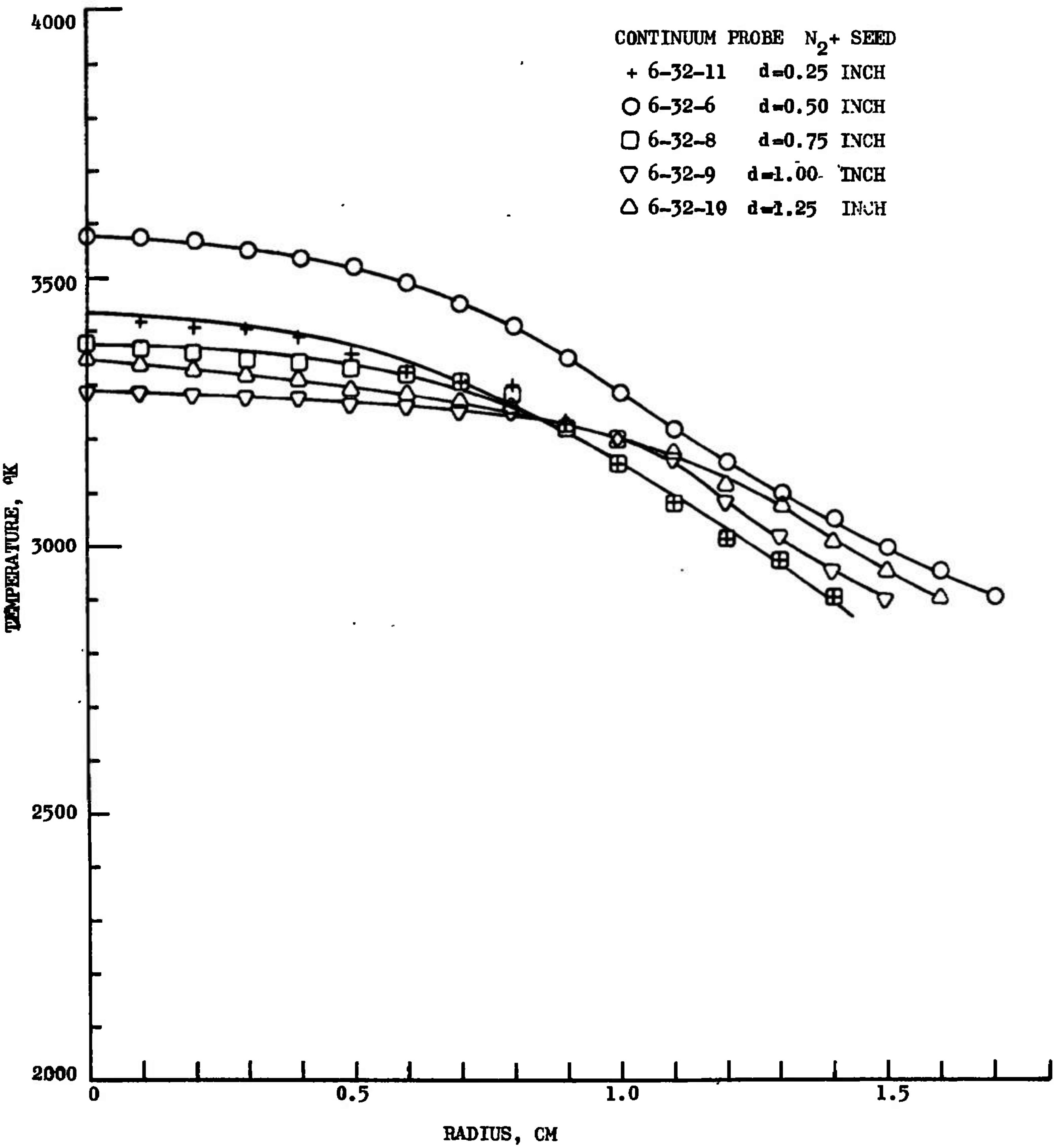

Fig. 18 Temperatures Determined from the Distributions in Fig. 17

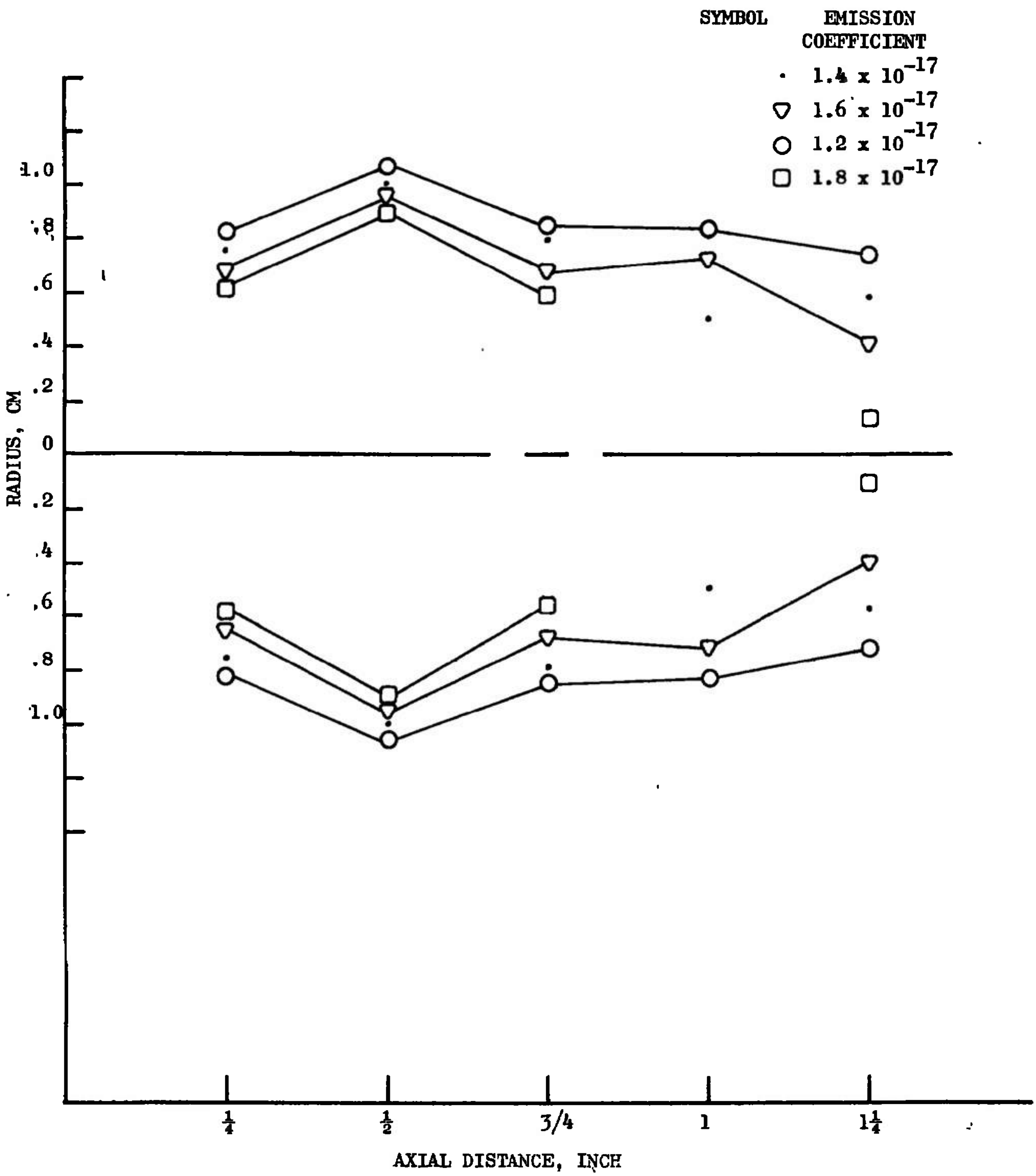

Fig. 19 Contours of Equal Continuum Emission Coefficient Crossplotted from Fig. 18

TABLE III

SUMMARY OF TEST DATA
SPECTROSCOPIC TEMPERATURE MEASUREMENT
PWT 2-MEGAWATT ARC FACILITY

RUN 118, PART 1

POINT	V_A	I_A	P_A	P_G	$\dot{m}_t$	h_t	p_t	T_t	Seed Rate	Probe Used	Dist. from Nozzle Exit	REMARKS
	(volt)	(amp)	kw	kw	lb/sec	kcal/kg	atm	°K	wt %K			
	Except as Indicated ±10	±2	±10	±10	±.002		±0.05	±100	$\frac{\dot{m}\ K}{\dot{m}_t} \times 100$		(In.)	
										(NITROGEN)		
1	$1600^{\pm 30}$	450	720	472	.20	1243	3.52	4160	0	Spectroscopic	1/4	During these runs (N_2 only) the power to the arc heater
2	$1640^{\pm 35}$	450	738	492		1295	3.51	4300			1/4	increased throughout the run as indicated by the variation
3	$1650^{\pm 15}$	450	742	491		1292	3.64	4300			1/4	in voltage. The values of h_t and T_t are average values
4	$1630^{\pm 15}$	445	725	475		1250	3.58	4190			1/2	over the entire run.
5	$1660^{\pm 35}$	450	747	488		1284	3.55	4270			1/4	
										(AIR)		
6	1260	722	910	572	.20	1506	4.06	3825	0	Spectroscopic	1/4	
7	1380	726	1002	611		1609	4.11	3950			1/4	
8	1340	722	967	603		1588	4.06	3925			1/4	
9	1340	720	965	615		1620	4.11	3975			1/2	
10	1400	720	1008	-		-	-	-			3/4	Water leak developed in heater during this run.
11	1380	712	982	588		1550	4.10	3900			-	Arc heater checkout run - No spectrographic data taken.
12	1320	720	950	600		1579	4.10	3920			1/4	
										(AIR + SEED)		
13	1260	717	903	585	.207	1487	4.10	3800	0.55	Spectroscopic	1/4	
14a	1245	622	774	433		1102		3300			1/2	During Run 14 there was a step increase in current;
14b	1280	659	844	519		1321		3600			1/2	however, according to heat loss data the listed current is low.
15	1250	730	912	592		1506		3820			3/4	
16	1240	720	893	571		1452		3760			1.0	
17	1240	705	874	552		1403		3705			1.0	
18	1200	728	874	557		1417		3720			1/4	
19	1260	720	907	571		1453		3765			1/4	
20	1255	715	897	561		1428		3750			1/4	
21	1250	700	875	562		1430		3750			1/4	
22	1260	728	917	580		1476		3800			1/4	Run terminated after approximately 2 min by H_2O pressure interlock.
23	1200	722	866	546		1389		3700			1/4	

V_A - Total arc volts
I_A - Total arc current
$P_A = V_A I_A$
K - Potassium

$\dot{m}_t$ - Total weight flow - Gas + Seed
ht - Total enthalpy
T_t - Total temperature
$P_G = P_A - \text{Losses}$

pt - Total pressure

as the continuum probe in the previous series of tests. A wavelength drive was added to the spectrograph which permitted wavelength scans from 3300Å to 7300Å and also made it possible to make all the adjustments of the spectrograph within the control room. The initial runs of this series on the unseeded nitrogen plasma were made merely to demonstrate the consistency of the experimental measurements.

The symmetry of the lateral distributions measured during this series of tests was better than that observed during the nitrogen tests of Series I. The jet, both seeded and unseeded, showed a flatter profile. Even in the case of the re-run on pure nitrogen there appeared to be a more uniform central core as the results of Figs. 20 and 21 show. The reproducibility when compared with the earlier data is impressive. The random fluctuations in the measured intensity were quite similar to those observed with the previous nitrogen runs. The shapes of the lateral distributions measured in the air jet, with or without seed, varied between the two normalized shapes shown as a and b in Fig. 22, depending upon the position of measurement along the jet axis. The centrally peaked profile seems to coincide with the location of the nodal points of the existing diamond shock pattern. These profiles are quite different in shape from those observed with the pure nitrogen jet which are characteristic of the one shown as c in Fig. 22 for comparison. It should be pointed out that the flat type of distributions observed in the seeded air plasma are characteristic of a jet having a uniform radial distribution for the emission coefficient.

Wavelength scans were measured in the integrated intensity emitted along the jet diameter and normal to the axis for pure nitrogen, pure air and seeded air plasmas. Such a scan for the seeded air jet, when compared with the mercury spectrum, showed lines of potassium superimposed on the continuous background.

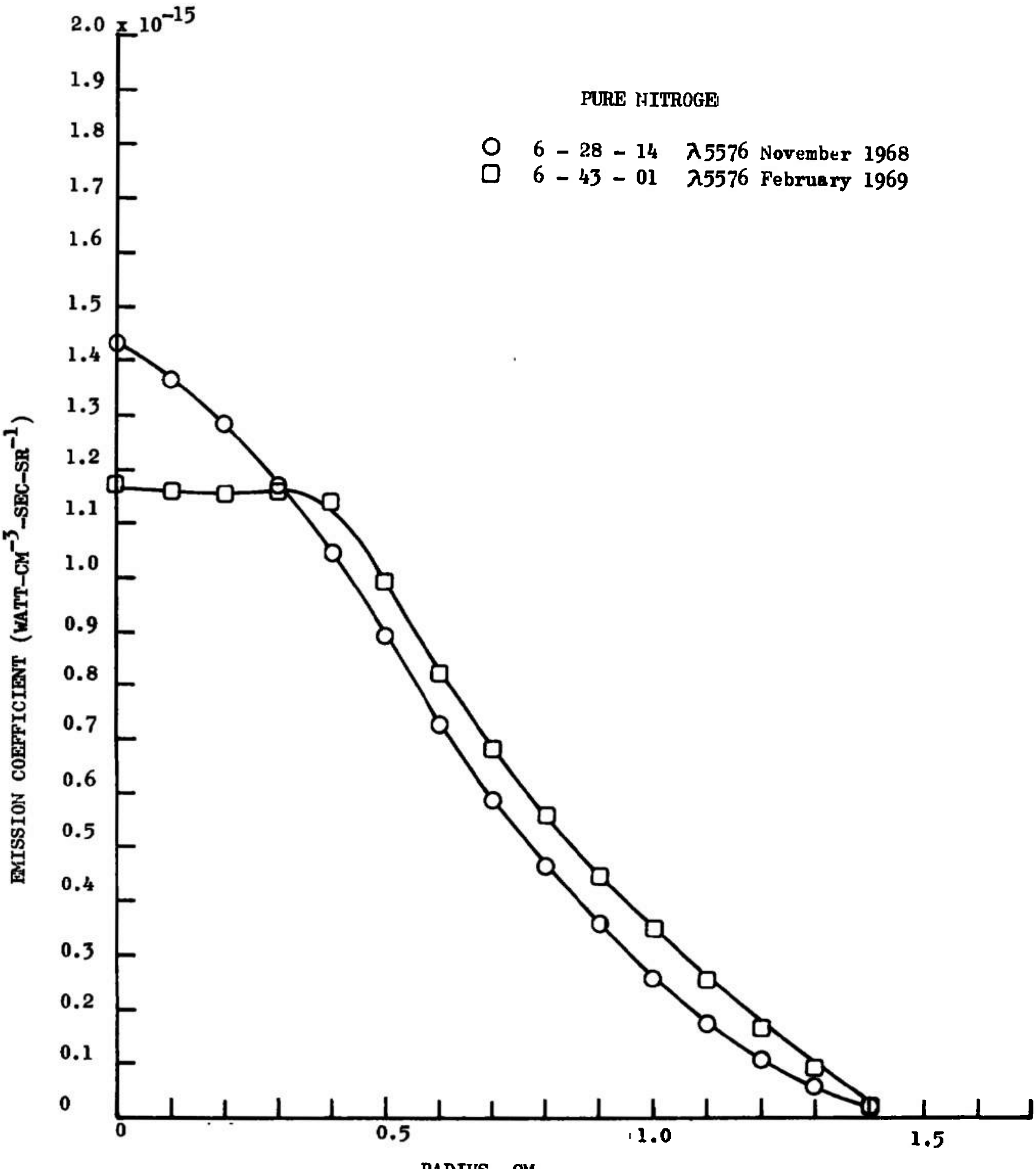

Fig. 20 Emission Coefficient versus Radius; Comparison between the λ5576 Continuum Data Taken in November 1968 and February 1969 in a Pure Nitrogen Plasma

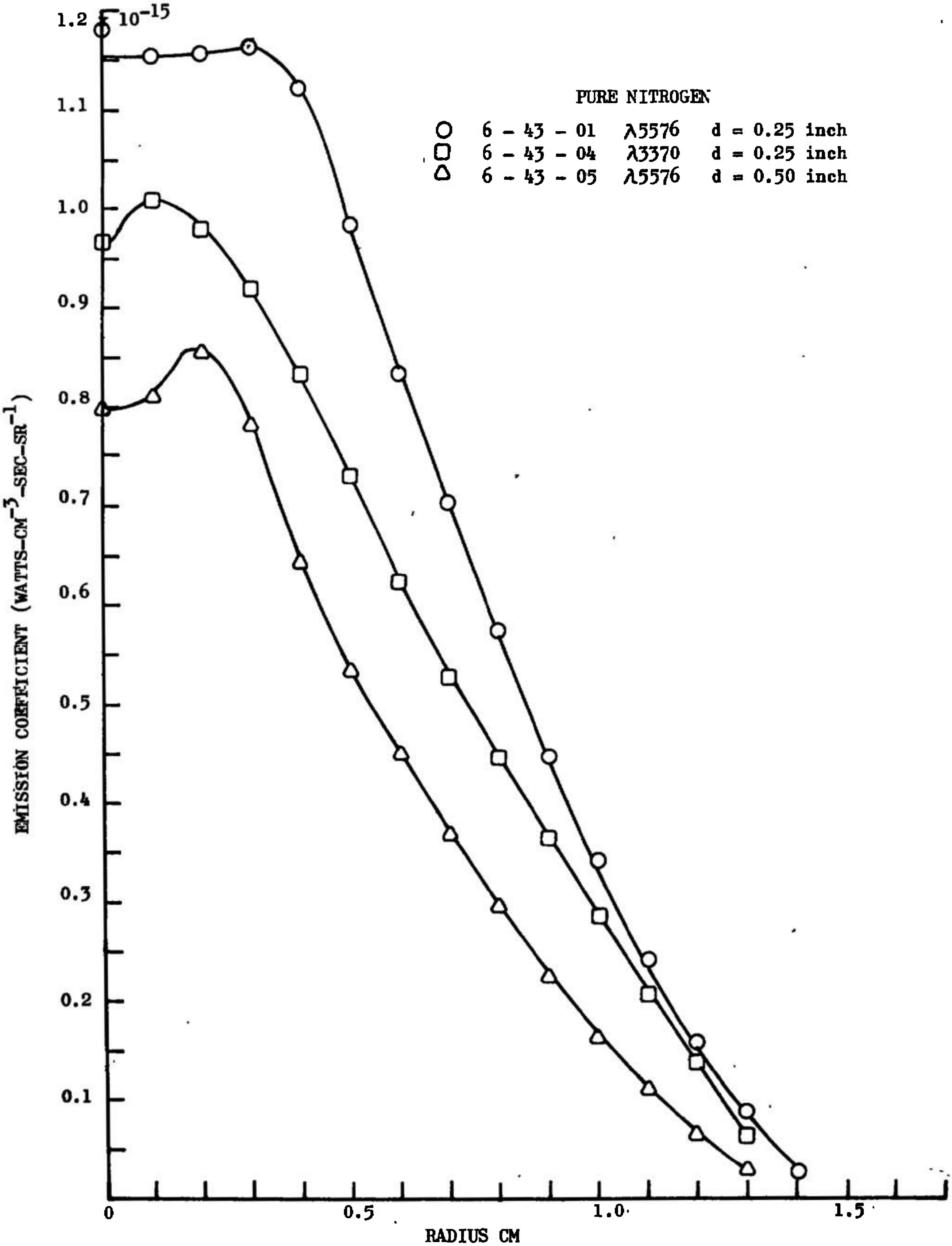

Fig. 21 Emission Coefficient versus Radius for the λ5576 and λ3370 Continuum in a Pure Nitrogen Plasma

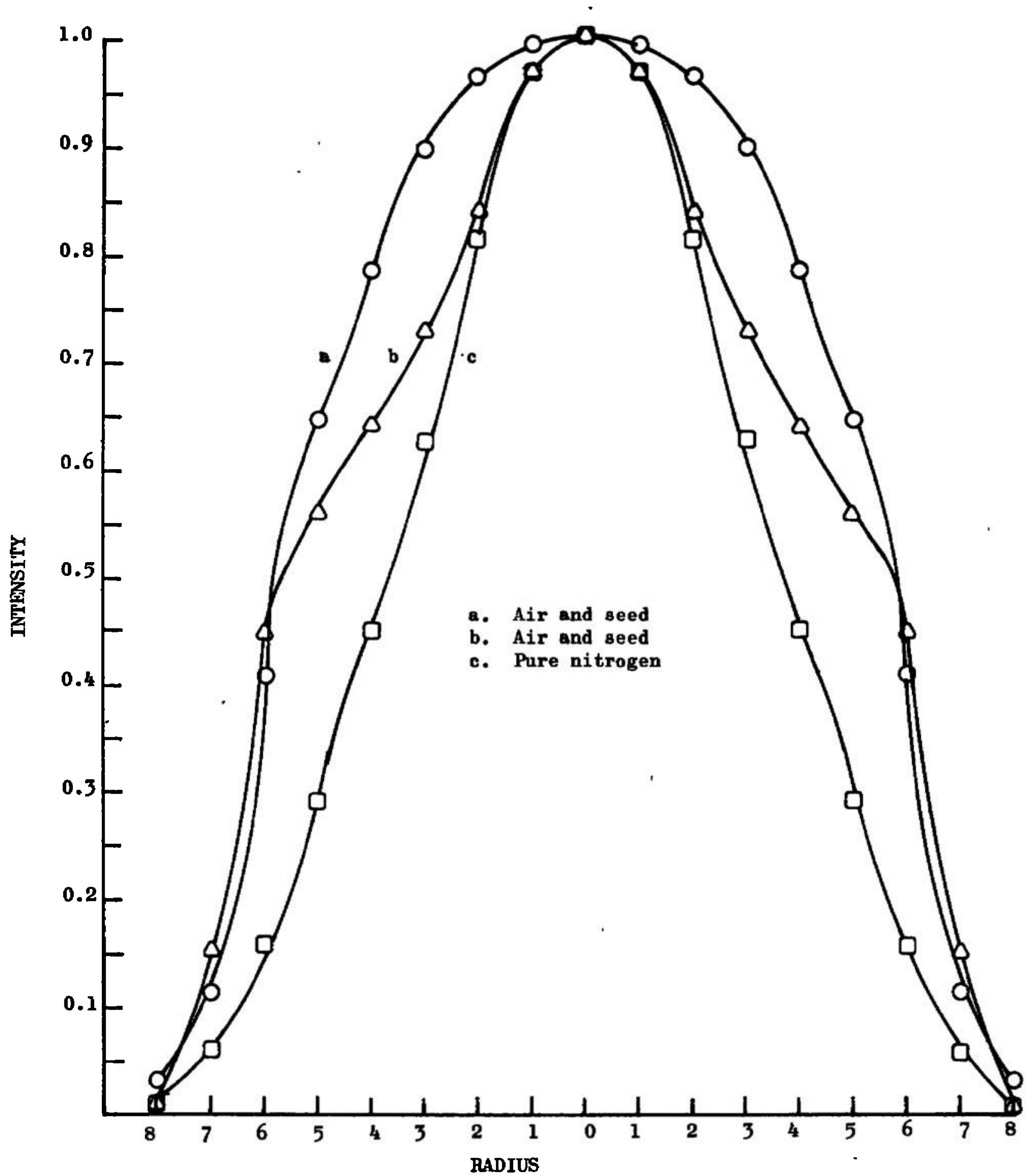

Fig. 22 Comparison of General Shapes of Lateral Intensity Distributions for Different Positions in the Jet and Different Seed Conditions

From a similar scan for the pure nitrogen jet the spectrum shows no discrete lines which were positively identified above the background. The (0,0) vibrational bands of the $\lambda 3371$ $N_2(2+)$ and $\lambda 3914$ $N_2^+(1-)$ systems could be positively identified above the strong continuum and some higher vibrational bands of these systems were barely discernable. In the case of unseeded air the band systems tended to blend into the continuum whereas some lines of the copper spectrum appeared along with the sodium D lines and a broad line which possibly could be identified as the H_β line of hydrogen. With the addition of seed material the copper lines disappeared along with the H_β line and all of the characteristic potassium quadruplet groupings appeared with the strong resonance doublets ($\lambda 3446$ and $\lambda 4044$). With seed present the strong sodium D lines persisted and the integrated continuum at $\lambda 5576$ increased only by a factor of about 1.2. On the other hand the integrated continuum for the pure nitrogen plasma was observed to be a factor of 15 higher than for the seeded air plasma.

2. Experimental Results

The results of the spectroscopic measurements are presented in graphical form in Figs. 23 through 28. The operating conditions for the heater can be determined from Table III and Table IV using the PSL trace numbers which have been corellated with the AEDC "points" in Table IV. Although the air plasma jet exhibited considerably improved symmetry during these tests and operated with somewhat improved stability, the radial distributions of emission coefficients and consequently of temperatures showed considerably greater variation from run to run as demonstrated by Fig. 23. The same effect on temperature is shown in Fig. 28. The central peaks in the measured lateral distributions which produce these sharp increases on the jet axis were very real as evidenced by the fact that they were reproduced in each of

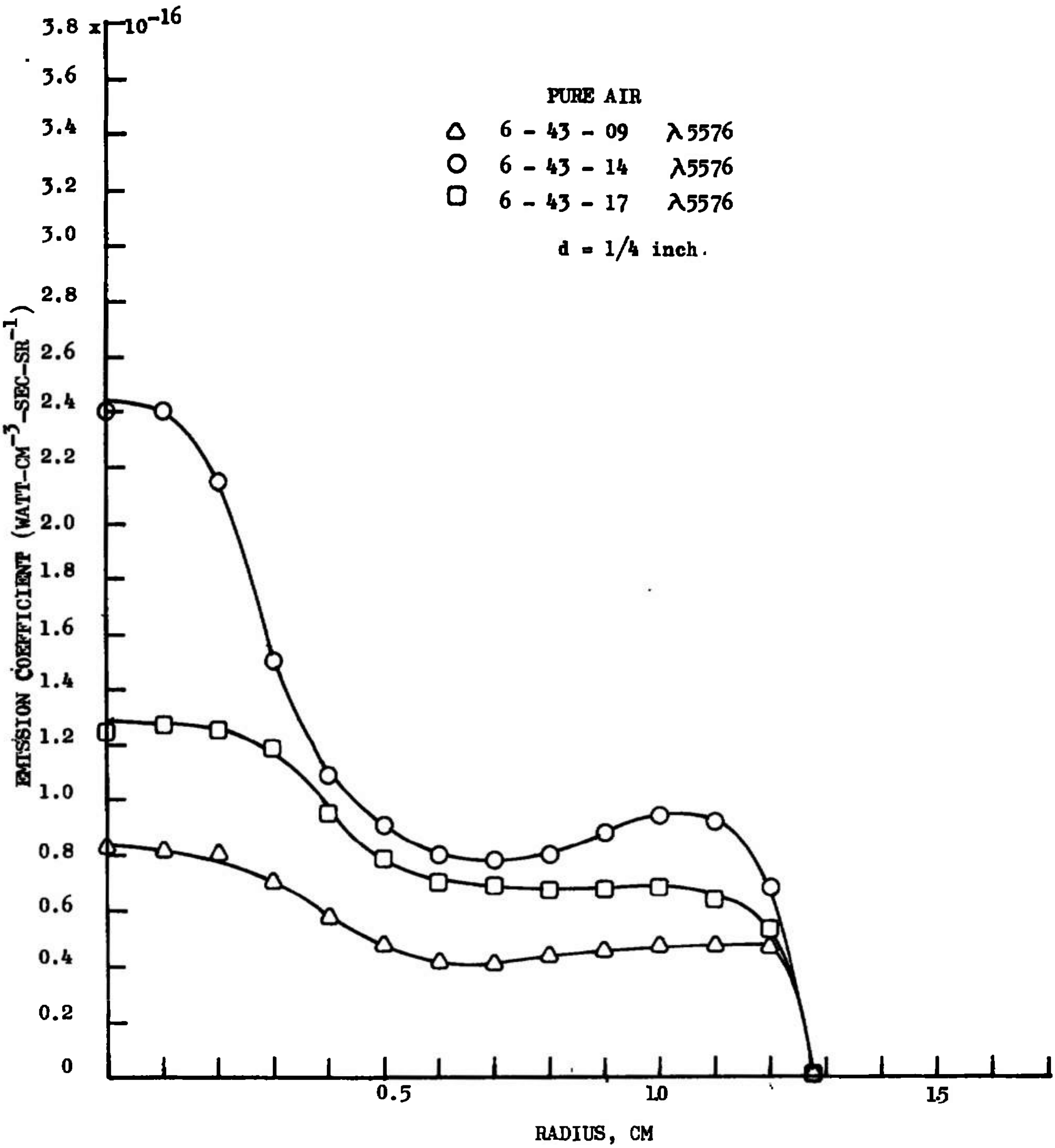

Fig. 23 Emission Coefficient versus Radius for the λ5576 Continuum in a Pure Air Plasma

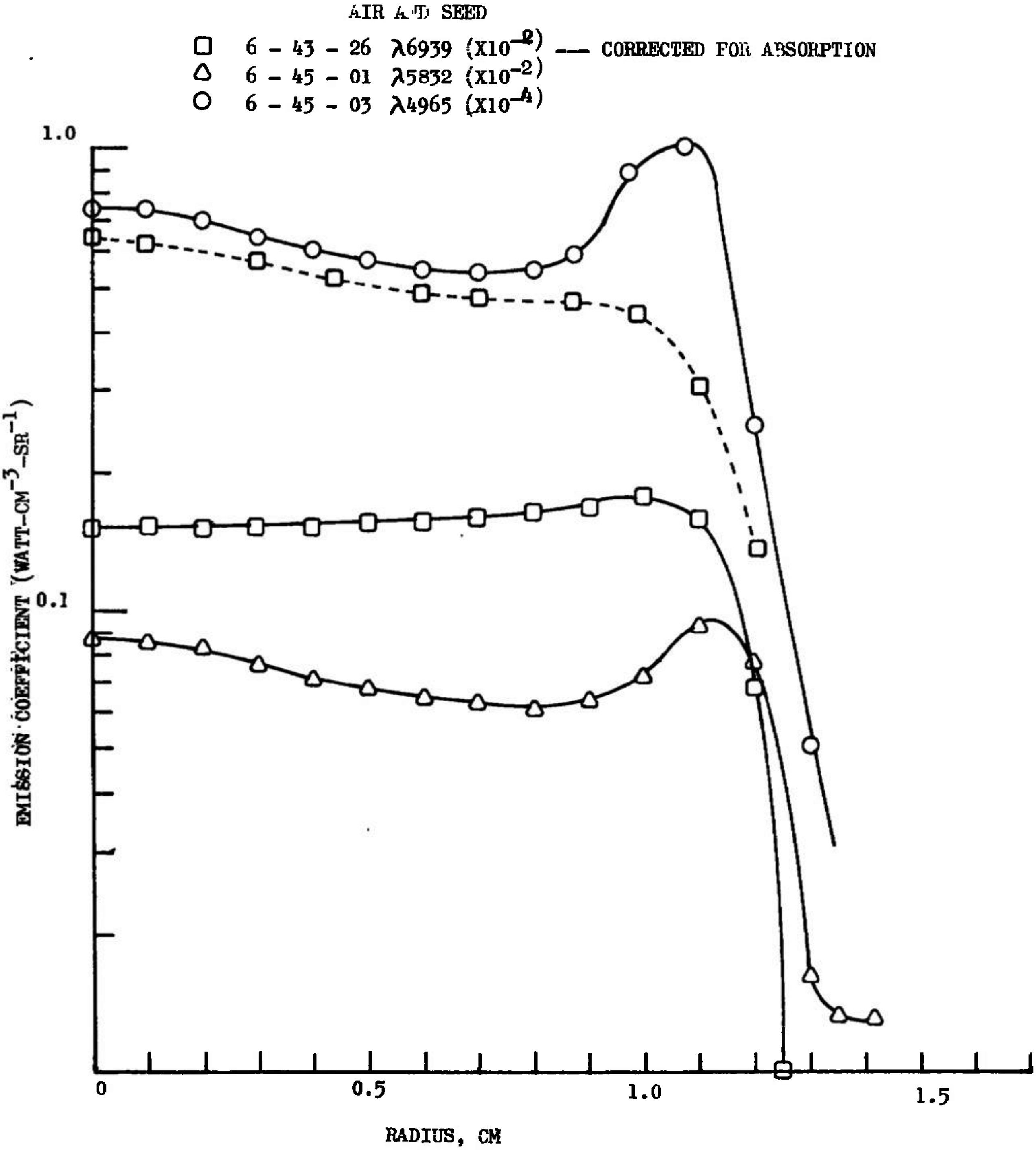

Fig. 24 Emission Coefficient versus Radius for Three Lines of Potassium in a Seeded Air Plasma

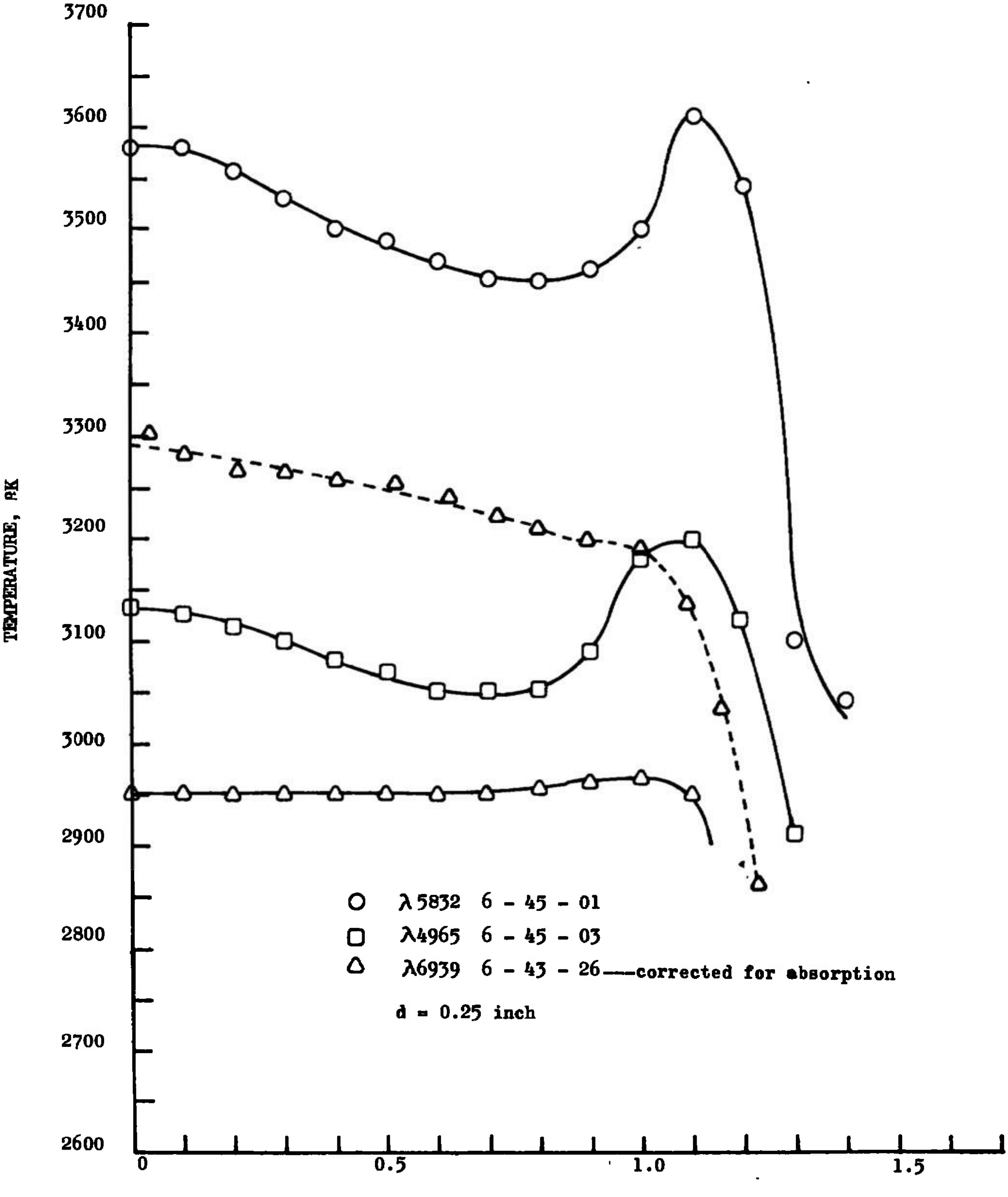

Fig. 25 Temperature versus Radius for the Three Potassium Seed Lines in a Seeded Air Plasma

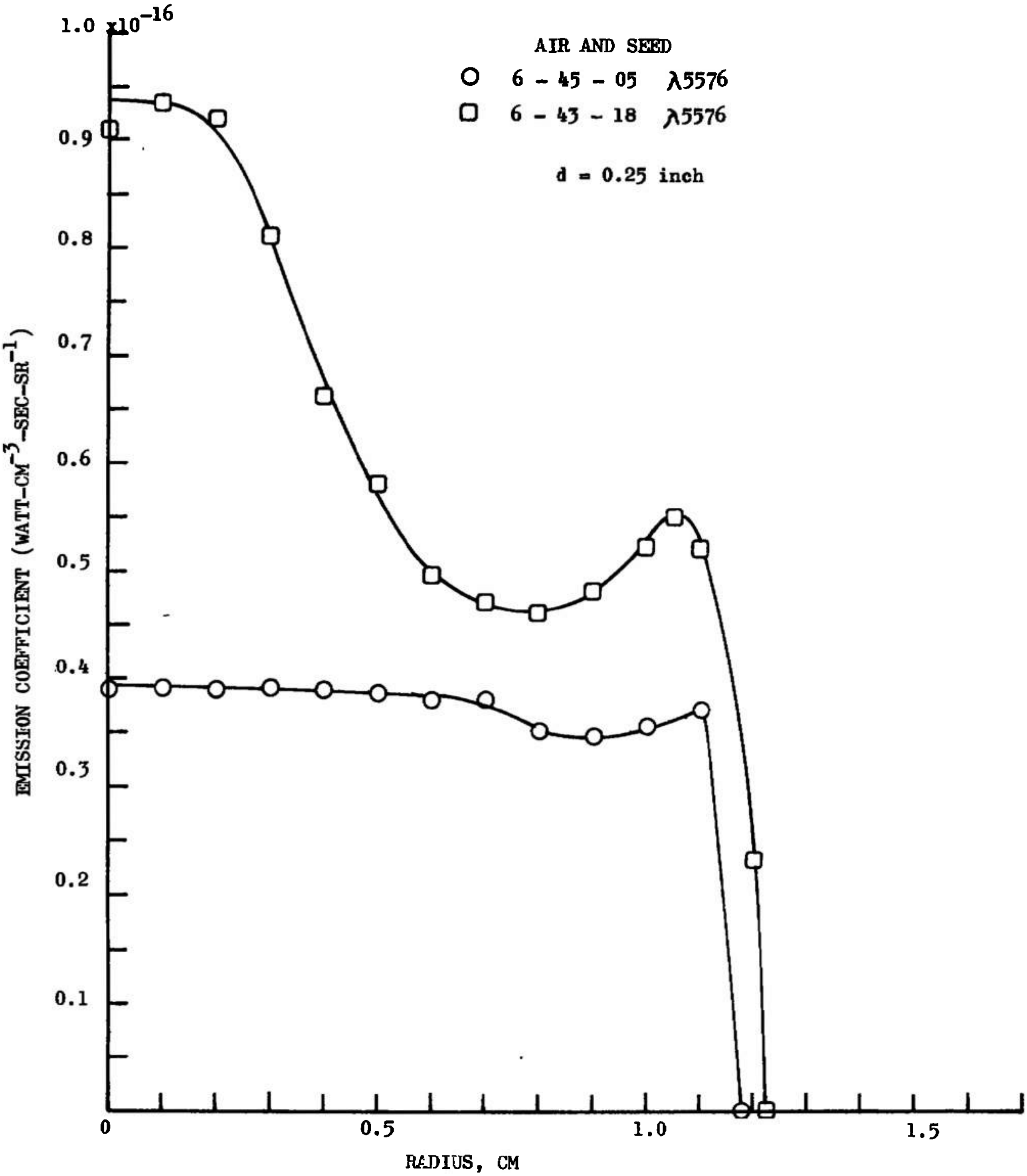

Fig. 26 Emission Coefficient versus Radius for the λ5576 Continuum in a Seeded Air Plasma

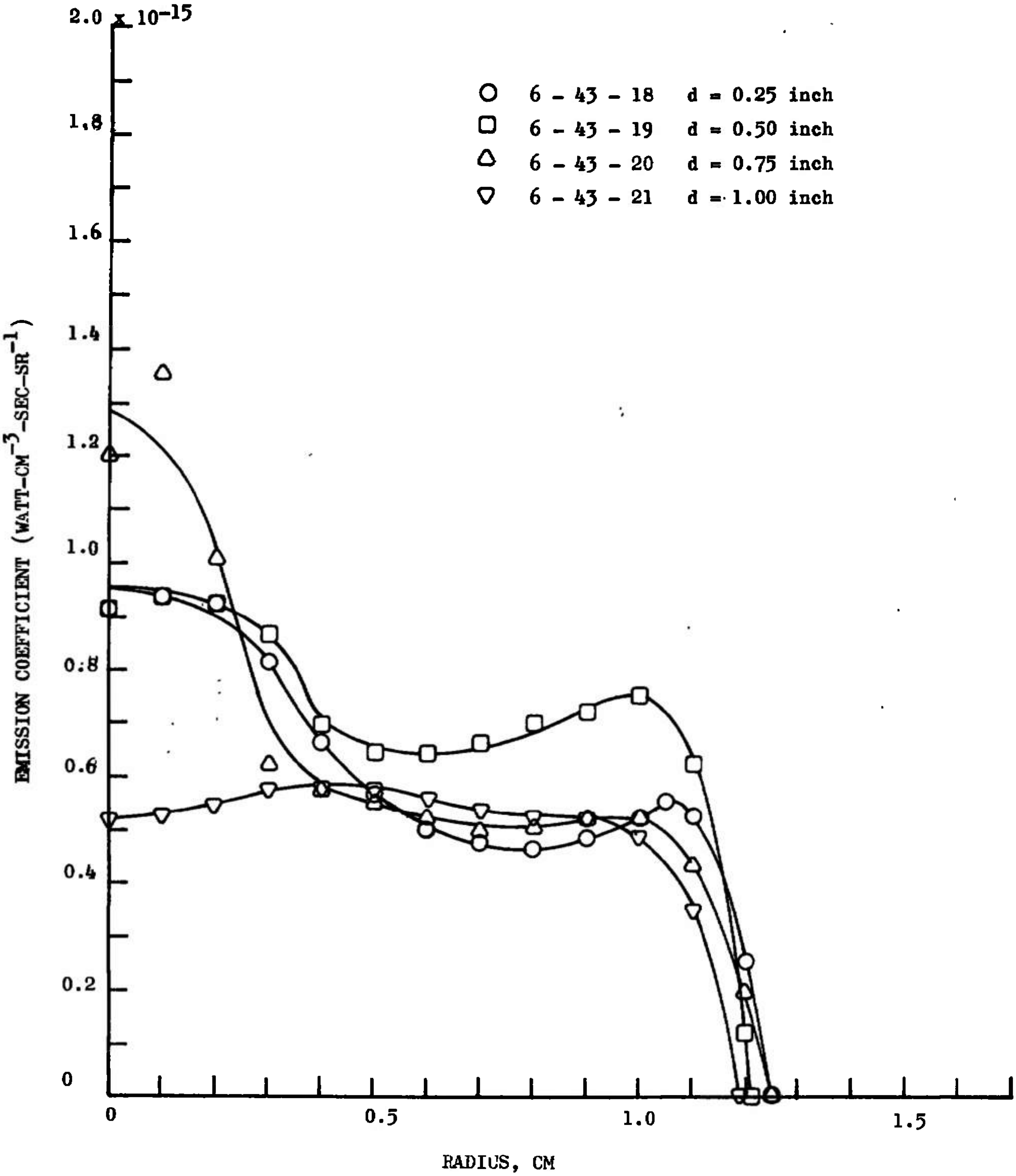

Fig. 27 Emission Coefficient versus Radius for the λ5576 Continuum for Four Different Axial Positions in a Seeded Air Plasma

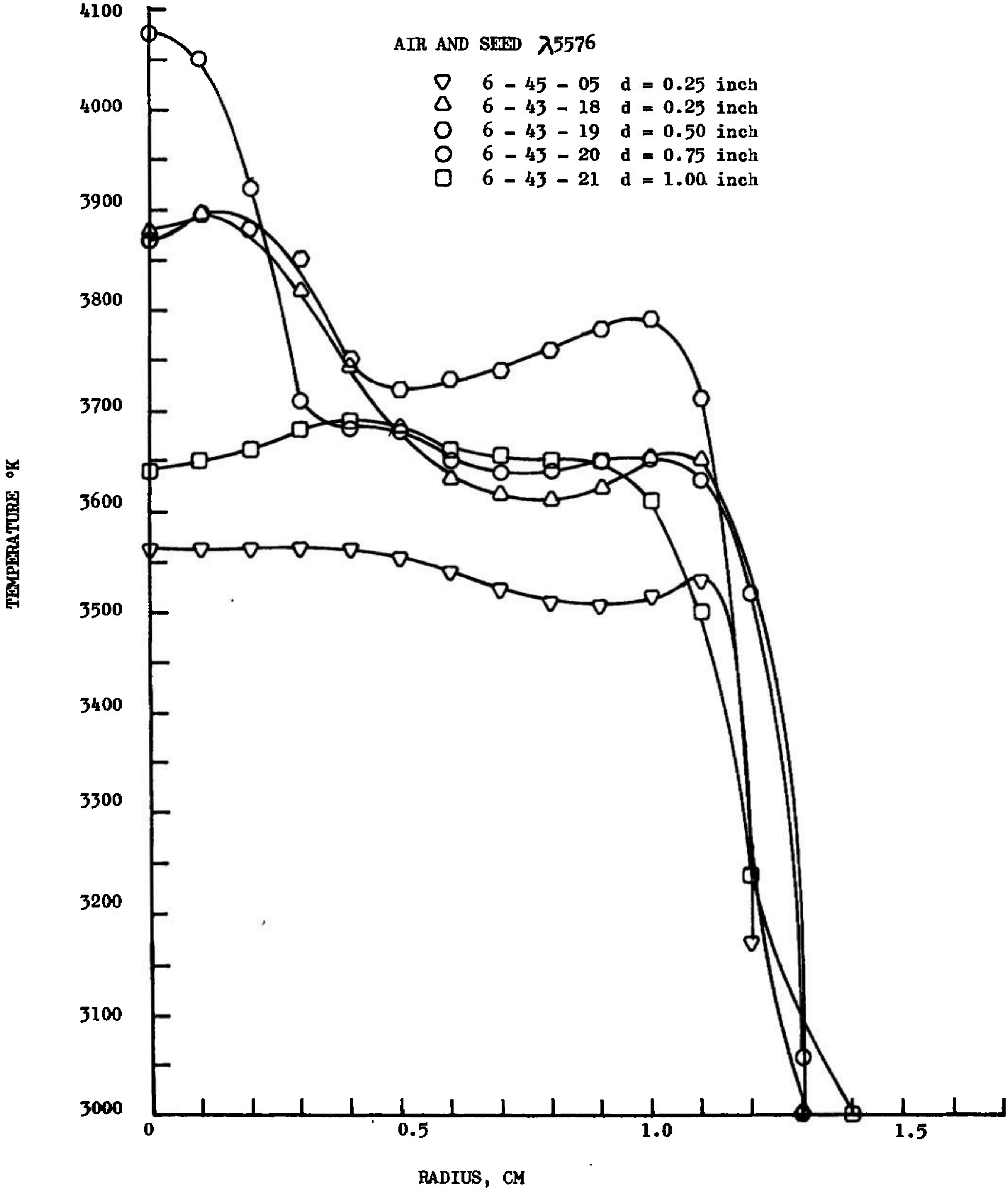

Fig. 28 Temperature versus Radius for the λ5576 Continuum for Four Different Axial Positions in a Seeded Air Plasma

Table IV. Summary of Data for correlation of AEDC & PSL tests.

Trace No.	Wave-length	Type	Gas	Seed Con-cent. (%)	Gas Flow (SCFH)	Current (Amps)	Voltage (Volt)	Remarks
6 - 35 - 1	7469	Atom Line	Nitrogen	0	49.4	100	227	PSL Jet #1
6 - 35 - 2	4935	Atom Line	Nitrogen	0	49.4	100	227	PSL Jet #1
6 - 35 - 4	3914	Band Head	Nitrogen	0	49.4	100	227	PSL Jet #1
6 - 35 - 6	3926	Continuum	Nitrogen	0	49.4	100	227	PSL Jet #1
6 - 35 - 7	5640	Continuum	Nitrogen	0	49.4	100	227	PSL Jet #1
6 - 35 - 9	3914	Band Head	Nitrogen	0	45.3	117	220	PSL Jet #1
6 - 35 - 11	7469	Atom Line	Nitrogen	0	45.3	117	220	PSL Jet #1
6 - 35 - 12	5640	Continuum	Nitrogen	0	45.3	117	220	PSL Jet #1
6 - 36 - 1	7469	Atom Line	Nitrogen	0	42	112	226	PSL Jet #1
6 - 36 - 2	5640	Continuum	Nitrogen	0	42	112	226	PSL Jet #1
6 - 36 - 3	3914	Band Head	Nitrogen	0	42	112	226	PSL Jet #1
6 - 36 - 5	3914	Band Head	Nitrogen	0	42	112	226	PSL Jet #1
6 - 36 - 7	3914	Band Head	Nitrogen	0	68	75	255	PSL Jet #1
6 - 36 - 9	5640	Continuum	Nitrogen	0	68	75	255	PSL Jet #1
6 - 36 - 10	7469	Atom Line	Nitrogen	0	68	75	255	PSL Jet #1
6 - 36 - 19	7469	Atom Line	Nitrogen	0	42	110	225	PSL Jet #1
6 - 36 - 22	3914	Band Head	Nitrogen	0	42	110	225	PSL Jet #1
6 - 36 - 21	5640	Continuum	Nitrogen	0	42	110	225	PSL Jet #1
6 - 43 - 26	6939	K Line	Air	0.55				AEDC #20
6 - 45 - 1	5832	K Line	Air	0.55		AEDC Series II		AEDC #21
6 - 45 - 3	4965	K Line	Air	0.55				AEDC #22
6 - 45 - 5	5576	Continuum	"	"				AEDC #23

Table IV. (cont)

Trace No.	Wave-length	Type	Gas	Seed Con-cent. (%)	Gas Flow (SCFH)	Current (Amps)	Voltage (Volt)	Remarks
6 - 39 - 1	7469	Atom Line	Nitrogen	0	41	120	193	PSL Jet #II
6 - 39 - 2	5640	Continuum	Nitrogen	0	41	120	193	PSL Jet #II
6 - 39 - 3	3914	Band Head	Nitrogen	0	41	120	193	PSL Jet #II
6 - 39 - 5	7469	Atom Line	Nitrogen	0	71	100	212	PSL Jet #II
6 - 39 - 6	5640	Continuum	Nitrogen	0	71	100	212	PSL Jet #II
6 - 39 - 7	3914	Band Head	Nitrogen	0	71	100	212	PSL Jet #II
6 - 39 - 9	7469	Atom Line	Nitrogen	0	108	100	215	PSL Jet #II
6 - 39 - 10	5640	Continuum	Nitrogen	0	108	100	215	PSL Jet #II
6 - 39 - 11	3914	Band Head	Nitrogen	0	108	100	215	PSL Jet #II
6 - 43 - 1	5576	Continuum	Nitrogen	0				AEDC #I
6 - 43 - 4	3370	Continuum	Nitrogen	0				AEDC #3
6 - 43 - 5	5576	Continuum	Nitrogen	0				AEDC #4
6 - 43 - 9	5576	Continuum	Air	0				AEDC #6
6 - 43 - 14	5576	Continuum	Air	0				AEDC #8
6 - 43 - 15	5576	Continuum	Air	0		AEDC		AEDC #9
6 - 43 - 16	5576	Continuum	Air	0		Series II		AEDC #10
6 - 43 - 17	5576	Continuum	Air	0				AEDC #12
6 - 43 - 18	5576	Continuum	Air	0.55				AEDC #13
6 - 43 - 19	5576	Continuum	Air	0.55				AEDC #14
6 - 43 - 20	5576	Continuum	Air	0.55				AEDC #15
6 - 43 - 21	5576	Continuum	Air	0.55				AEDC #16
6 - 43 - 25	6939	K Line	Air	0.55				AEDC # 19

Table IV. (cont)

Trace No.	Wave- length	Type	Gas	Seed Con- cent. (%)	Gas Flow (SCFH)	Current (Amps)	Voltage (Volt)	Remarks
6 - 57 - 4	5500	Continuum	Nitrogen	0				AEDC #1a
6 - 57 - 5	5500	Continuum	Nitrogen	0				AEDC #1b
6 - 57 - 6	5500	Continuum	Nitrogen	0				AEDC #2a
6 - 57 - 7	5500	Continuum	Nitrogen	0				AEDC #2b
6 - 57 - 8	5500	Continuum	Nitrogen	0				AEDC #2c
6 - 57 - 11	5832	Atom Line	Nitrogen	0.52				AEDC #4
6 - 57 - 12	5600	Continuum	Nitrogen	0.52				AEDC #5
6 - 57 - 17b	6938	Atom Line	Nitrogen	1.88				AEDC #7
6 - 57 - 18	6938	Atom Line	Nitrogen	0.33				AEDC #8
6 - 57 - 19	6970	Continuum	Nitrogen	0.33		AEDC		AEDC #8
6 - 57 - 20	6938	Atom Line	Nitrogen	0.33		Series III		AEDC #8
6 - 57 - 25	6938	Atom Line	Air	1.72				AEDC #9a
6 - 57 - 26	6950	Continuum	Air	1.72				AEDC #9b
6 - 57 - 27a	6950	Continuum	Air	0.39				AEDC #10a
6 - 57 - 27b	6500	Continuum	Air	0.39				AEDC #10b
6 - 58 - 43	6950	Continuum	Air	0.28				AEDC #11
6 - 58 - 44	6938	Atom Line	Air	0.28				AEDC #11
6 - 58 - 47	5832	Atom Line	Air	0.28				AEDC #13
6 - 58 - 48	6938	Atom Line	Air	0.28				AEDC #14
6 - 58 - 49	6950	Continuum	Air	0.28				AEDC #14
6 - 58 - 50	6950	Continuum	Air	0.28				AEDC #14

the three repeated lateral distributions that were averaged before the inversion process. The change from a centrally peaked profile to a flat profile resulting from changes of 1/4 inch in position along the jet axis was observed in the air jet with or without seed but not in the pure nitrogen jet. The degree of sharpness and flatness appeared to be more pronounced with seed present; however, these characteristics were not present in the distributions of the seed lines which were measured only at the 1/4 inch position (measured from the nozzle exit). This is the position, however, where the most pronounced peaks were observed in the continuum.

The shape of the lateral profile for the λ5832 KI line did tend to show some central peaking. This line also yielded a temperature profile which is much higher than that given by either the λ4965 or λ6938KI lines. A closer examination of the wavelength traces indicates that it is entirely possible that the sodium D lines were erroneously measured instead of the λ5832 KI line as supposed. The flat distribution obtained from the λ6938 KI line is probably more accurate because of the ability to completely separate it from the neighboring λ6911 KI line in the measured wavelength distribution. It has also been generally observed that the seed lines give lower temperatures than the continuum, unless correction is made for self-absorption which has the greatest effect on the longest wavelength and lowest energy line.

C. SERIES III. POWER AND SEED RATE CHANGES

The third of the series of AEDC tests was made to study the effect of seed rate and input power level on the determination of temperatures in seeded nitrogen and air plasmas. A total of fourteen independent runs were made with seed rates ranging from 0.28 to 1.88 per cent by weight and input power

levels ranging from 275 to 1059 kw. A summary of the test data for these runs is given in Table V which has been provided by the PWT-LOHRO Branch of ARO.

1. Experimental Measurements

In this series as in the second series, only the spectrograph was used as the spectral probe. The probe was made to traverse the jet in a fixed plane (normal to the axis) at a position 1/4 inch from the nozzle exit. This position was maintained throughout the series. In all runs at a given seed rate the power level was adjusted during the run so that all spectral measurements for a given seed rate were made on a continuously running jet as indicated by the lettered designations of the AEDC run numbers in Table V. As a precaution, five spectral probings were first made on the unseeded nitrogen jet to establish the reproducibility of the probe by comparison with the previous tests. These runs were also needed to separate wherever possible, the effect of power level changes from seed rate changes in the subsequent runs.

2. Experimental Results

The results of the unseeded nitrogen tests demonstrated reasonable reproducibility of the probe system but exhibited an anomaly in so far as the effect of power change is concerned. Whereas the calculated average total temperatures increased with power input the measured emission coefficient for the continuum was observed to decrease. This indicated that either the diamond shock pattern generally observed in the supersonic stream had shifted with respect to the spectral probe or the distribution of energy between the static and kinetic form was affected by the change in input power level. It is possible that this anomaly is connected with the supersonic stream since it has not been observed in the PSL tests on subsonic streams.

The results of the six spectral probings of the seeded

ARO, INC.
Arnold Air Force Station, Tennessee
ENGINEERING WORK SHEET

TABLE V
SUMMARY OF TEST DATA
PWT 2-MEGAWATT ARC FACILITY
RUN 120, PART 1

PROJECT NO. PL3017 PAGE NO
ENG. J. M. Whoric DATE July 1969
COMPUTED BY
CHECKED BY

	V_A (volt) Except as Indicated ±10	I_A (amp) ±2	P_A kw ±10	P_G kw ±10	$\dot{m}_t$ lb/sec ±.002	h_t kcal/kg	P_t atm ±0.05	T_t °K ±100	Seed Rate wt %K $\frac{\Delta K}{\dot{m}_t}$	Dist. from Nozzle Exit (In.)	REMARKS
									(NITROGEN)		
1a	1560	422	658	417	.20	1098	3.29	3725	No Seed	1/4	V_A - Total arc volts
1b	1575	672	1058	580	↓	1526	3.92	4890	↓	↓	I_A - Total arc current
											P_A - V_A I_A
2a	1570	421	661	426	.20	1122	3.29	3800	No Seed		K - Potassium
2b	1580	670	1059	580		1526	3.97	4890			$\dot{m}_t$ - Total weight flow - Gas + Seed
2c	1570	175	275	207	↓	545	2.44	1975	↓		h_t - Total enthalpy
								(NITROGEN + SEED)			T_t - Total temperature
3	1400	425	595	363	.207	924	3.41	3195	0.52		P_t - Total pressure
4	1410	430	606	373	.207	949	3.39	3260	0.52		
5a	1440	430	619	381	.207	969	3.51	3325	0.52		
5b	1420	682	968	506	↓	1287	3.98	4295			
6	1375	450	619	367	.212	912	3.65	3150	1.88		
7	1382	450	622	370	.212	918	3.70	3175	1.88		
8a	1440	450	648	399	.206	1021	3.51	3490	0.33		
8b	1440	710	1022	535	.206	1369	4.16	4505			
									(AIR + SEED)		
9a	$1240^{\pm 20}$	720	893	519	.211	1296	4.15	3600	1.72		
9b	$1400^{\pm 40}$	345	483	347	.211	866	3.75	2850	↓		Voltage $1440^{\pm 10}$ first half of run and $1360^{\pm 10}$ second half of run. 1400 is average value of voltage for entire run at second power setting.
10a	1280	740	947	576	.206	1472	4.15	3800	0.39		
10b	1520	352	535	386	↓	985	3.75	3100	↓		
11	$1280^{\pm 40}$	752	962	586	.206	1499	4.15	3800	0.28		Arc heater cathode developed water leak near end of run.
12		756									No data - Arc heater cathode failure.
13	1260	750	960	610		1558	4.15	3900	0.28		
14a	1300	750	975	596		1524	4.15	3850	0.28		
14b	1580	357	564	404	↓	1032	3.75	3200	0.28	↓	

nitrogen plasma are given in Figs. 29 and 30 and are summarized in Table VI along with data from Series I and II, some of which has been corrected for absorption. With seed present the intensity anomaly described above was not observed; with this in mind the results of this series can be considered significant. The measured continuum gives the most consistent results when the determined temperatures are compared with the mean values obtained from an energy balance and aerodynamic corrections to static temperatures.

Absorption corrections of the potassium lines did reduce the discrepancy between the temperatures determined from the continuum and lines in previous tests. The greatest change occurred for the λ6938 KI line as can be seen in Figs. 24 and 25 where results with and without absorption corrections are shown; absorption corrections for the continuum were negligible. The results of a similar series of tests on the seeded air plasma show equally good agreement with the temperatures determined from an energy balance; changes were in the proper relation to power level changes. These results are shown in Figs. 31 and 32 and in Table VI.

All the data inverted during this series of tests were processed with the Matrix Inversion Program for Absorbing Plasmas (MIPAP) which was previously developed for the Air Force under Contract F-33615-67-C-1071-P002 with the Aerospace Research Laboratories, Wright-Patterson Air Force Base.

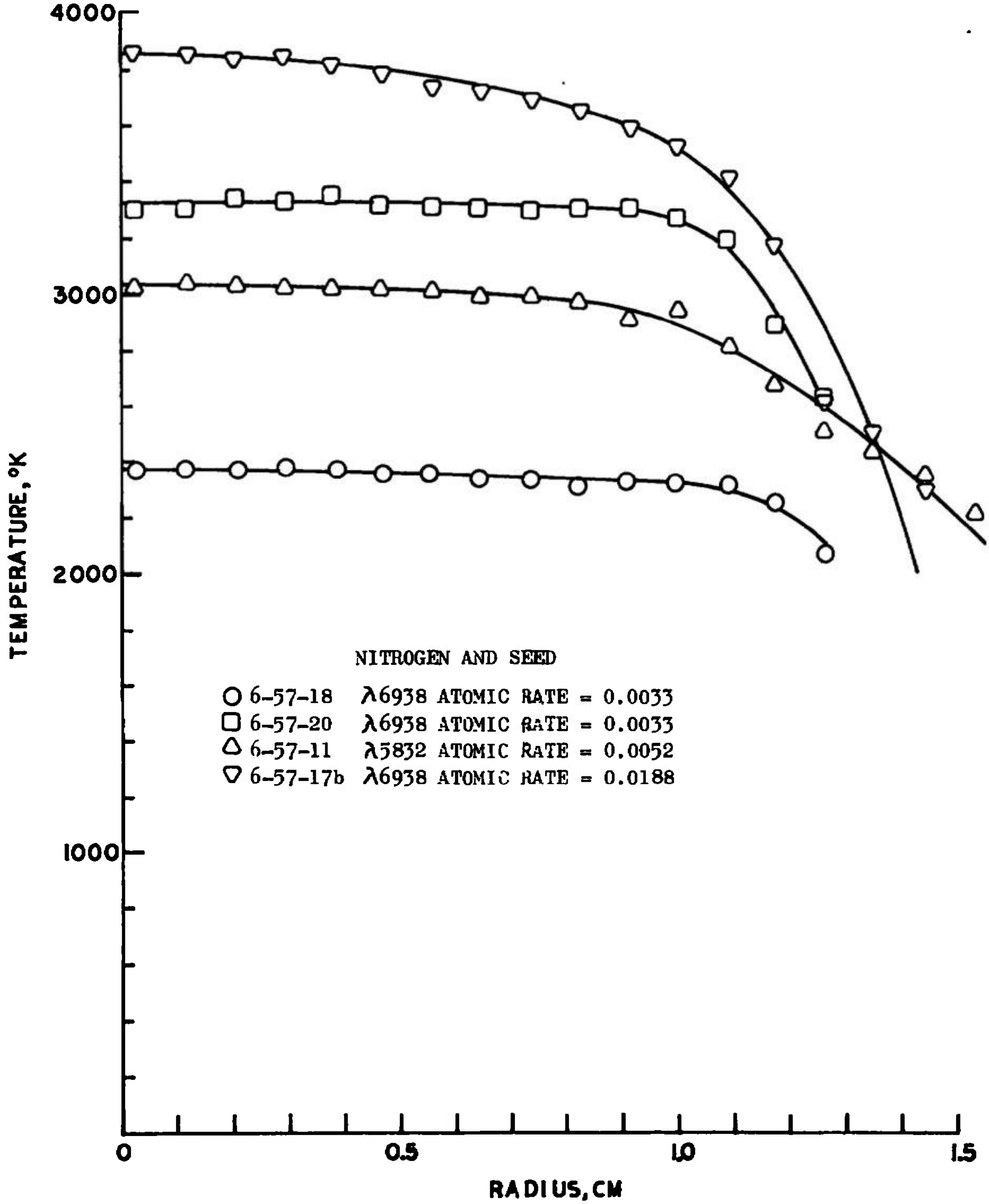

Fig. 29 Radial Distributions of Temperatures Measured for Seeded 1-atm Nitrogen Plasmas Using Two Potassium Lines and Three Seed Rates

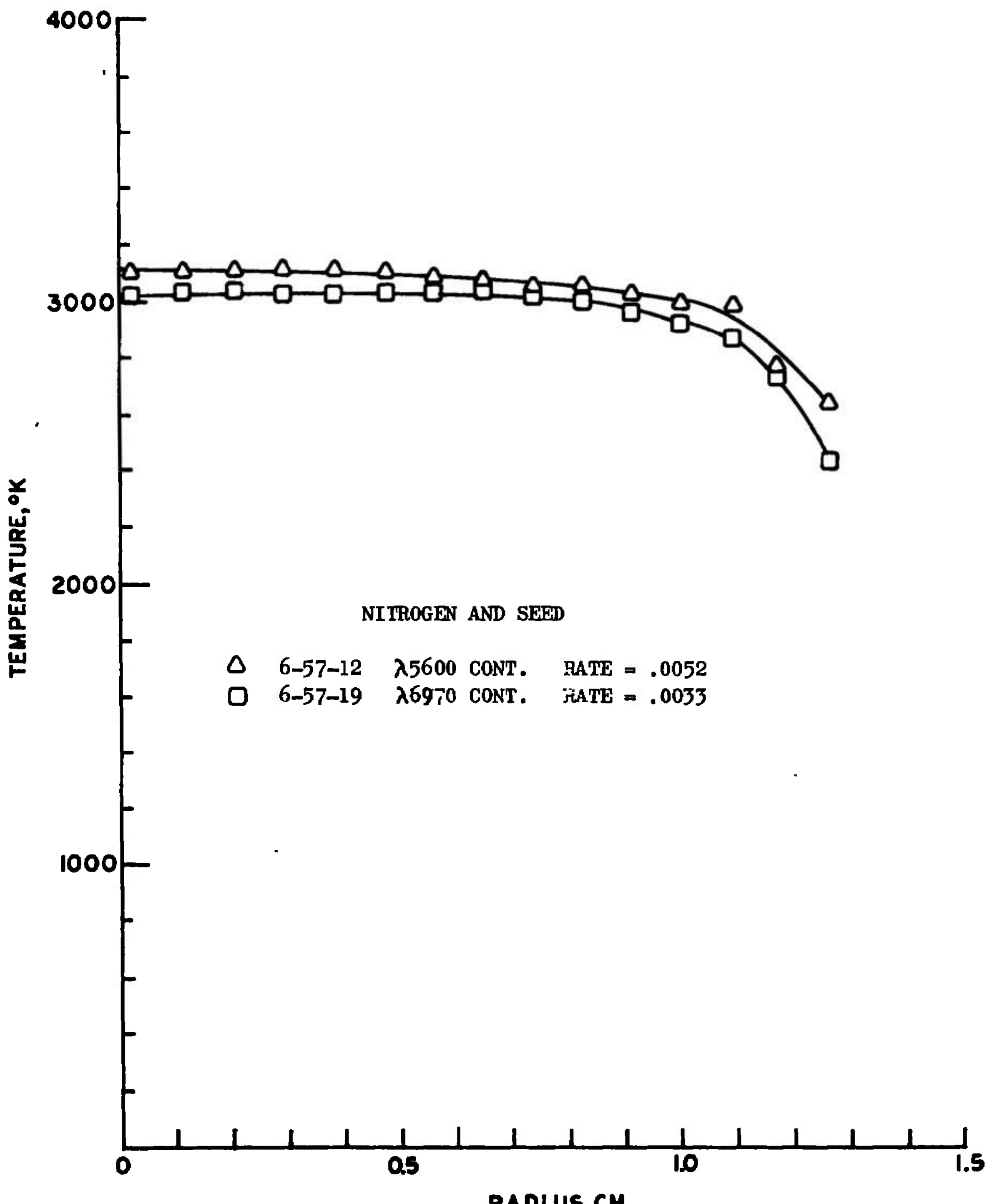

Fig. 30 Radial Distributions of Temperatures Measured for Seeded 1-atm Nitrogen Plasmas at Two Seed Rates Using the Continuum at Two Wavelengths

Table VI. Summary of experimental results of spectral measurements of static temperatures and comparison with those obtained from Aerodynamic computation using the total temperature determined from measured energy balance. d=0.25 inch except for one point.

			TEMPERATURE °K			
			TOTAL	STATIC		
	SEED	SPECTRAL	From Energy	SPECTRAL	AERODYNAMIC	
GAS	by wt.	SPECIES	Balance		Equilibrium	Approx. Finite Rate
N_2	0	Band Head	4574	5000 *	3348	3218
N_2	0	Cont.	3800	8600	2770	2660
N_2	0	Cont.	4890	7600	3580	3440
N_2	0	Cont.	1975	8900	1373	
N_2	0.46	Line	4040	3400 *	2920	2800
N_2	0.46	Cont.	4021	3470 *	2895	2775
N_2	0.46	Line	4198	3100 *	3030	2910
N_2	0.46	Line	4120	3430	2960	2855
N_2	0.46	Cont.	4082	3400 *	2938	2825 **
Air	0.55	Cont.	3700	3550 *	3060	2753
Air	0.55	Line	3750	3275	3105	2790
Air	0.55	Line	3750	3500 *	3105	2790
Air	0.55	Line	3800	3100 *	3105	2830
N_2	0.52	Line	3260	3030	2345	2245
N_2	0.52	Cont.	4295	3140	3090	2993
N_2	1.88	Line	3175	3800	2250	2152
N_2	0.33	Line	3490	2366	2512	2408
N_2	0.33	Cont.	4505	3020	3270	3140
N_2	0.33	Line	4505	3347	3270	3140
Air	1.72	Line	3600	3200	2970	2650
Air	1.72	Cont.	2850	2700	2335	2060
Air	0.39	Cont.	3800	3240	3140	2825
Air	0.39	Cont.	3100	2620	2560	2275
Air	0.28	Cont.	3800	2940	3145	2825
Air	0.28	Line	3800	2710	3145	2825
Air	0.28	Line	3900	3450	3235	2900
Air	0.28	Line	3850	2950	3190	2865
Air	0.28	Cont.	3850	3620	3190	2865
Air	0.28	Cont.	3200	2880	2645	2395

* Spectral data not corrected for absorption.
** d=0.5 inch.

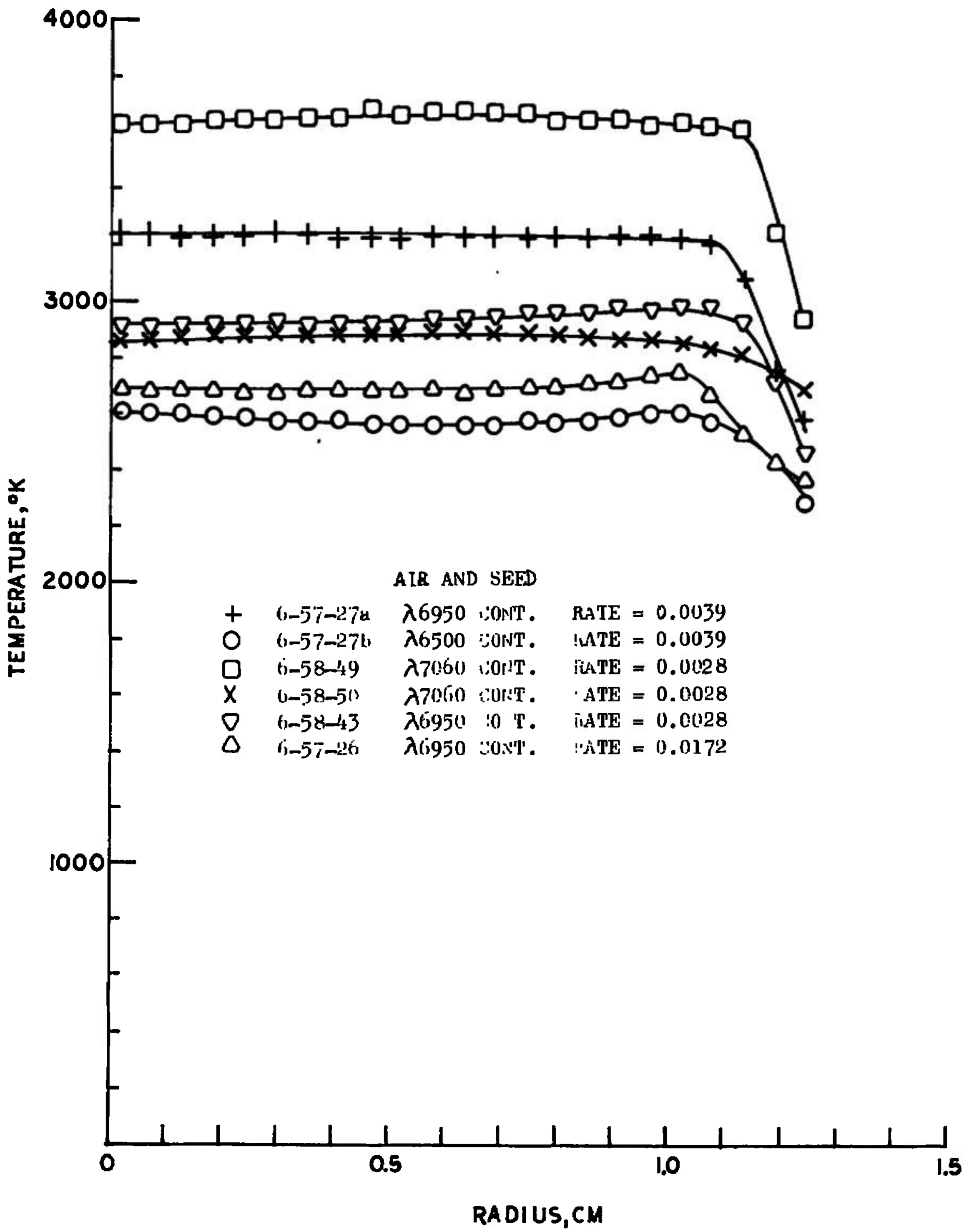

Fig. 31 Radial Distributions of Temperatures Measured for Seeded 1-atm Air Plasmas at Three Seed Rates Using the Continuum at Three Wavelengths

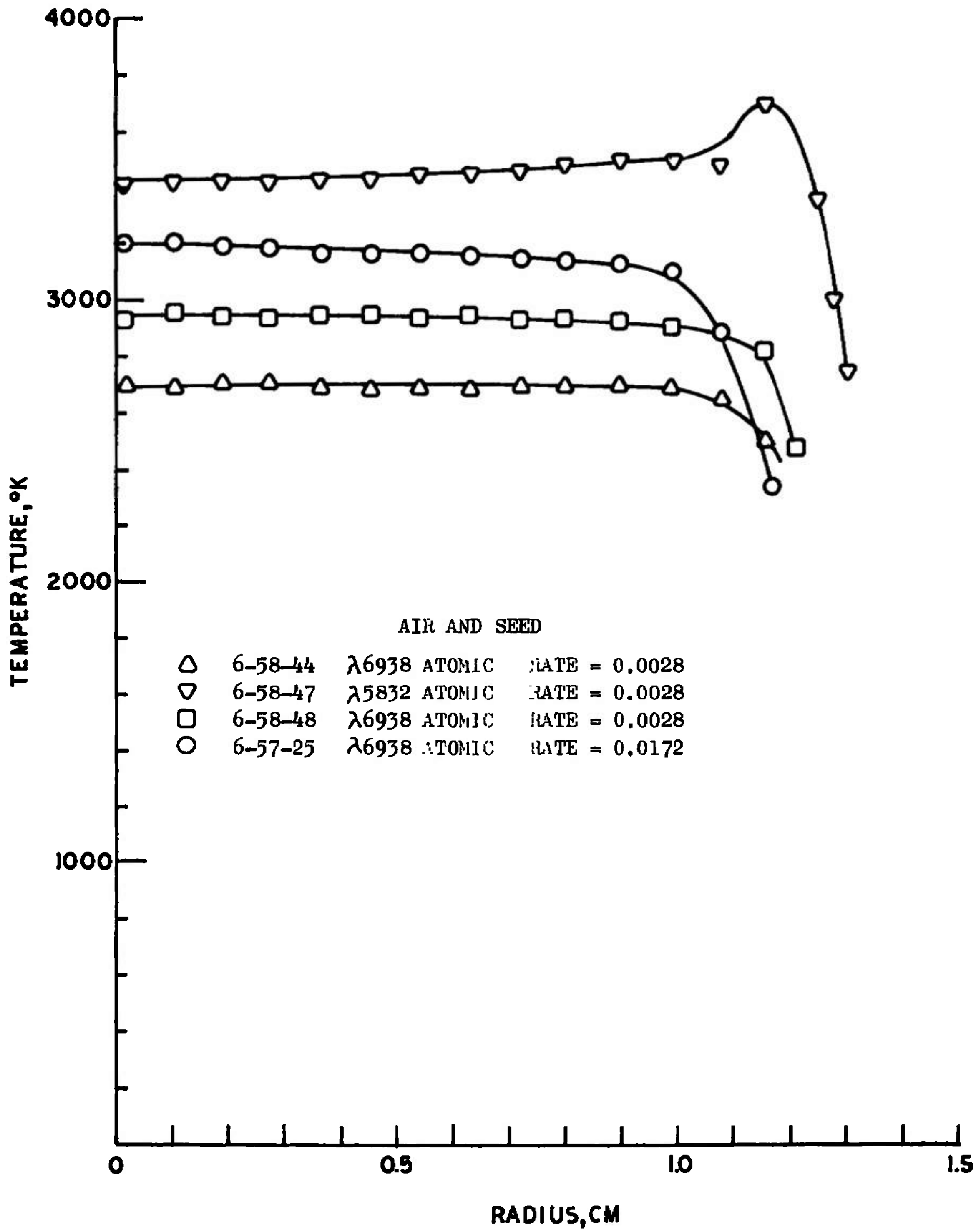

Fig. 32 Radial Distributions of Temperatures Measured for Seeded 1-atm Air Plasmas Using Two Lines and Two Seed Rates

IV. EXPERIMENTATION AT PSL

A. UNSEEDED NITROGEN PLASMA

An initial step in the effort to understand the anomalously high level of continuum observed in pure nitrogen and air plasma jets in comparison with the Kramers-Unsold theory was taken at PSL through experiments with the cascade type arc jet. The aim of these experiments was to determine the plasma temperature from either or both an atomic spectral line or an increment of the molecular ion band system and use this temperature to calibrate the anomalous continuum.

1. Experimental Measurements

The plasma jet used in these experiments is described in Ref. 1. By changing the gas flow rate, current, length of constrictor section, and length of anode section the axis temperature was varied over the approximate range of 5000°K to 10000°K. At the high temperatures of this range both the $\lambda 7469$ atomic line and an increment of the $\lambda 3914$ $N_2^+(1-)(0,0)$ band near the head could be observed along with the continuum. At temperatures below about 6000°K only the band system could be used for calibration. The operating conditions for the jet used in this series of experiments are shown in Table IV.

2. Experimental Results

Any two species of radiation measured in a given volume of plasma can be used as the coordinates of a point which, if the plasma is in equilibrium, should fall on what can be defined as an LTE characteristic curve (see Ref. 6) for the plasma. Such a comparison is made in Fig. 33 for the atomic line and band system mentioned above. The solid curve, with temperatures indicated was computed from the composition data given by Drellishak, et al.[3] Similar curves for seeded plasmas can be plotted for the computed data given in the Appendix.

The shape of the theoretical LTE curve is independent of

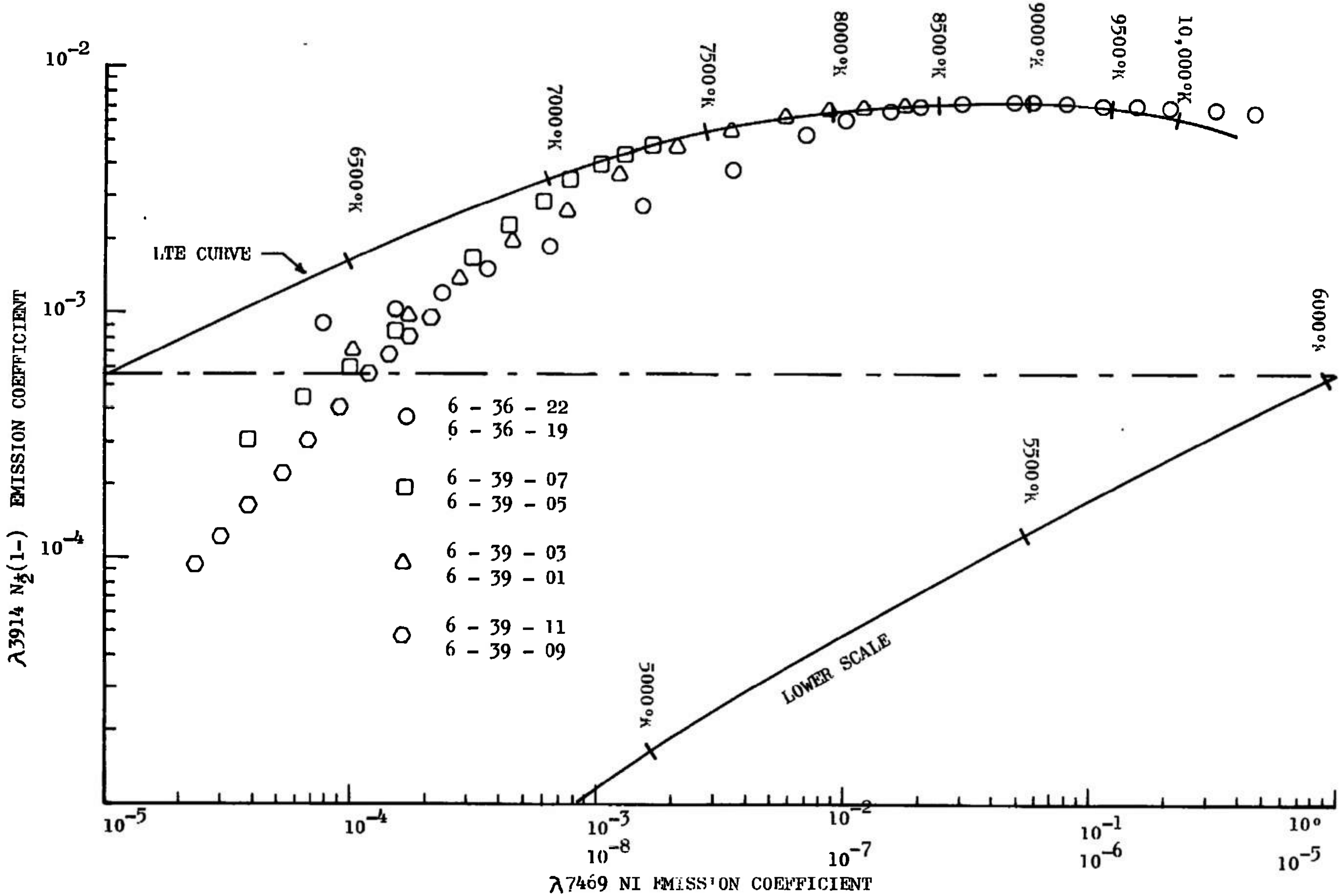

Fig. 33 Comparison of Experimental Data with Computed LTE Band Systems—Atom Line Characteristic Curves for 1-atm Nitrogen Plasma

the transition probabilities for the chosen species. The effect of the transition probability is to shift the curve, without changing its shape, along the scale corresponding with the species of radiation under consideration. The theoretical curve shown in Fig. 33 has been shifted horizontally and vertically to best fit the experimental data on the band head. Since the emission coefficient for the band head increment has been computed with a normalizing constant equal to the square of the electronic moment multiplied by the Franck-Condon factor, this graphical shift yields an experimental value of $1.36 \times 10^{-36} cm^2$ which is to be compared with the published value of $2.00 \times 10^{-36} cm^2$. The corresponding transition probability for the atom line is $2.05 \times 10^7 sec^{-1}$ which agrees reasonably well with the published value of $1.61 \times 10^7 sec^{-1}$. These discrepancies are not as serious as the observed deviations from thermal equilibrium.

The results of Fig. 33 indicate that non-equilibrium sets in not only at the edge of the jet where the temperature gradient is high but it also occurs on the jet axis when the temperature is reduced below about 7000°K. Morris, et al,[2] have pointed out that equilibrium in the wall stabilized arc did not persist at temperatures below 9000°K, however, in that case it was believed due to high thermal gradients at the edge of the plasma where the low temperatures were measured.

A similar plot of the $\lambda 5600\mathring{A}$ continuum against the $\lambda 7469$ NI atomic line is compared with the LTE characteristic curve in Fig. 34. Again the results show either a deviation from equilibrium or an error in computation of the emission coefficients. The observed deviation from the LTE characteristic curve in the direction of anomalously higher continuum at lower temperatures is consistent with the results of the AEDC tests on the unseeded jet. The data of Figs. 33 and 34 could be cross-plotted to yield a third type of LTE characteristic curve for the continuum

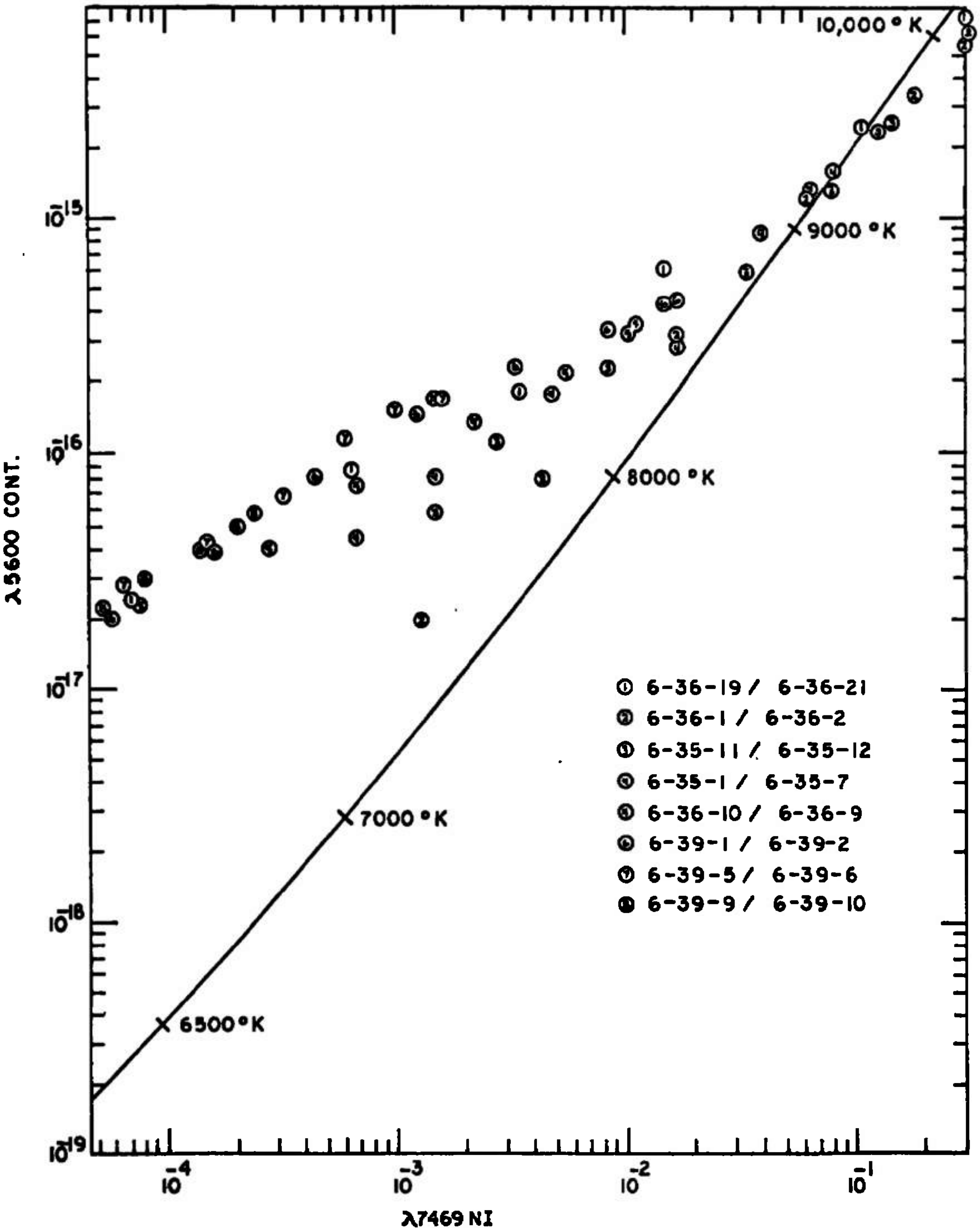

Fig. 34 Comparison of Continuum and λ7469 NI Line Emission Coefficients with Equilibrium Curve for Pure Nitrogen Plasma Jet. Curve is for Equilibrium Using Kramers-Unsold Theory for the Continuum

vs. band system which would have the advantage of permitting experimental measurements to lower temperatures. This has not been done, however, since it would not be possible to relate such a plot to temperature until one or both of the anomalies of Figs. 33 and 34 are eliminated.

V. CONCLUSIONS AND RECOMMENDATIONS

The results of spectral measurements of temperature in a plane 1/4 inch from the nozzle exit of nitrogen and air plasmas at varying levels of seeding and power input are summarized in Table VI. For comparison, total temperatures determined from the experimental energy balance and aerodynamically computed static temperatures provided by ARO are included in the table. The generally higher value of static temperature determined spectroscopically for the seeded plasmas is to be expected since the tabulated values represent the observed constant values across the relatively uniform high temperature core of the jet whereas the computed temperatures are mean values. The measured static temperature correlates well with the total temperature determined from the energy balance for all levels of power input and seed rates. The anomalously high measured temperatures in the unseeded plasmas vividly demonstrate a need for more basic research on the theory of the temperature dependence of optical radiation emitted from air and nitrogen plasmas. An initial step in this direction was taken in the series of experiments performed at PSL toward the end of this program.

In general the temperatures determined from the measured continuum intensities are more consistent than those determined from spectral lines of the seed material. The latter were always lower and therefore nearer the aerodynamically determined values. Corrections for self-absorption of the spectral lines raised the temperatures determined by the red λ6938 KI line into good agreement with those determined from the continuum. The continuum measurements were found to have entirely negligible absorption corrections. Even with absorption corrections the λ5832 KI and λ4965 KI lines still yielded slightly lower temperatures.

Freedom from absorption and the improved consistency of temperatures determined from the continuum has demonstrated that the continuum probe is the most practical of the two probes investigated here for making temperature measurements in seeded plasmas. Added to this advantage is that of the practical simplicity of the continuum probe. The lower limit of sensitivity demonstrated for the specific probe designed here is far more than adequate for measuring the continuous radiation in either seeded or pure air and nitrogen plasmas.

The simplicity of the continuum probe renders it particularly attractive as a potential tool for development into rapid scan diagnostic systems for studying the fluctuations in plasmas. In view of the slowness of the mechanical scanning system used here and the rather high degree of both spatial and temporal fluctuations observed in the arc heaters investigated, the consistency of the temperature measurements is quite impressive. Improvements in the results could be obtained only by making considerably more measurements with proper statistical analyses and by improving the stability and uniformity of the seed distribution or by analyzing in detail the fluctuations.

The shockingly high temperatures determined from continuum measurements in the unseeded plasmas points out the serious need for an extensive investigation to develope an improved theory for the temperature dependence of electron continuum at temperatures below 9000°K. Initial attempts were made in this direction by using the stable nitrogen plasma jet at PSL to measure the radiation from three different species. To properly judge the apparent non-equilibrium observed in the low temperature range would require a detailed investigation of the radiative properties of the molecular ion band before it can be safely used as a reference for calibrating the continuum. To completely eliminate any question regarding stability, aparatus must be developed to

permit simultaneous measurement of at least two species of radiation. A properly calibrated continuum temperature dependence, even without detailed theoretical interpretation, would be extremely useful for the further development of practical diagnostic methods for arc heaters. This would be required before the potential of the continuum probe as a practical control device for arc heaters could be fully developed.

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2. Morris, J. C., Krey, R. U., Garrison, R. L., "Radiation Studies of Arc Heated Nitrogen, Oxygen, and Argon Plasmas," ARL 68-0103 (May 1968).

3. Drellishak, K. S., Aeschliman, D. P., and Cambel, A. B., "Tables of Thermodynamic Properties of Argon, Nitrogen and Oxygen Plasmas," AEDC-TDR-64-12 (Jan 1964).

4. Hilsenrath, J., and Klein, M., "Tables of Thermodynamic Properties of Air in Chemical Equilibrium Including Second Virial Corrections from 1500 to 15000°K," AEDC-TR-65-58 (March 1965).

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6. Olsen, H. N., Bedjai, G., and Martindill, R. E., "Determination of Departures from Local Thermodynamic Equilibrium in Arc Plasmas," ARL 67-0060 (March 1967)

VI. APPENDIX

Fortran IV programs written for computation of number densities and emission coefficients of nitrogen and air plasma seeded with pure potassium are given here along with detailed flow charts and computer results for a range of seed levels (including zero) and temperatures. The results of zero seed have been compared with those of Drellishak,[3] et.al., for nitrogen and Hilsenrath,[4] et. al., for air. To initially check the reliability of the computations, Hilsenrath's data on air had first to be converted to number densities at constant pressure with the results shown in Table AI.

The mathematical descriptions of the computations are not repeated here since they are the same as those given in Ref. 1. In the course of this programing several typographical errors were discovered in Ref. 1. The questioned equations written in their corrected form are given as follows:

ERRATA FOR REF. 1

Page 10. $$P_3 + P_e aP/(P_e + S_1) + P_3^2/S_2 + 2P_e - P = 0 \tag{14}$$

Page 12. $$P_e = \sum_{i=4}^{6} P_i + \sum_{i=9}^{10} P_i + P_{12} \tag{19}$$

Page 20. $$f(\lambda_1 \lambda_3) = \lambda_1 \lambda_3 \left[\left(1 + \frac{S_2}{S_1}\right) \lambda_3 + \frac{S_3}{S_1} \lambda_1 \left(\frac{\lambda_1}{\lambda_3}\right)^3 \right]^{-1} \tag{33}$$

Page 21. $$\bar{\epsilon}_1 = 1.582 \times 10^{-16} \frac{N_1}{Z_1} g_T \left(1 + \frac{S_2}{S_3}\right) A_T f\left(\frac{\lambda_1 \lambda_3}{\lambda_1 \bar{\lambda}}\right) \exp\left[-\bar{E}_m/T\right]. \tag{34}$$

The subscripts used throughout both of the programs discussed below are defined by the following legend for the partial pressures and total pressure:

$P_1=P_K$	$P_7=P_{O_2}$
$P_2=P_{N_2}$	$P_8=P_O$
$P_3=P_N$	$P_9=P_{O_2^+}$
$P_4=P_{K^+}$	$P_{10}=P_{O^+}$
$P_5=P_{N_2^+}$	$P_{11}=P_{NO}$
$P_6=P_{N^+}$	$P_{12}=P_{NO^+}$
P_e=Electron	P_T=Total Pressure

The programs are designated DOSNIP (Diagnostic of Seeded Nitrogen Plasma) and DOSNOP (Diagnostic of Seeded Nitrogen/Oxygen Plasma). The procedure followed in both programs employs the Newton-Raphson method to numerically solve the polynomials expressing the electron partial pressure in terms of the total pressure, equilibrium constants and volume ratio of seed, A, to parent gas. The partition functions for all species of particles, with the exception of the potassium atom, are initially stored in the program. These numbers were taken from Gilmore's[5] tables for air. The ground state statistical weight of the potassium atom was used as an initial value and was then corrected within the program to a final value; the final value being compatible with the energy level cut-off corresponding with the final value of the electron partial pressure computed for a given initial value of the volume ratio, A, of seed material. The ground state statistical weight was used for the potassium ion. From the electron partial pressure and the equilibrium constants all other partial pressures are computed in turn.

Since the volume seed ratio, A, changes with temperature for a fixed mass ratio, B, it is necessary to iterate the computation of A as a function of B and the partial pressures until the volume seed ratio converges to the final value within the prescribed accuracy. It is for this reason that the multiply looped programs had to be

developed. Attempts to set up the initial equation in terms of B rather than A introduced considerably more complication.

The program for seeded reconstituted air was much more complicated than for nitrogen in that the polynomial relating the electron partial pressure to the equilibrium constants, total pressure and temperature could not be expressed as a single power series in P_e. Thus the direct mathematical applications of the Newton-Raphson method as in the case of nitrogen was not possible. This more complex system of equations led to the evaluation of two square roots which tended to have negative arguments for trial values of P_e outside of a specific but initially unknown range of positive values; in addition, this range of acceptable trial values for P_e was temperature dependent. The increased complexity of the air program demonstrated by comparison of the flow diagrams of Figs. A1 and A2 was due principally to the internal looping and testing required to reach the converged value of P_e for even the initial value of A. The terminology of these flow diagrams is consistent with the Fortran IV program listings of Tables AII and AIII. In addition to the convergence of A corresponding to the fixed value of B, the volume ratio of all species containing nitrogen to those containing oxygen, XIV, had to be converged to a specified accuracy as computed from the initial value of the mass ratio, XIM, within still another loop of the program.

When values of XIV, A and P_e have converged to the specified accuracy for the specified values of XIM and B at a given temperature and total pressure all partial pressures are converted to number densities. From these, emission coefficients for three potassium atomic lines, two atomic nitrogen lines, the electron continuum and finally the first 26 P-branch components of the $\lambda 3914$ $N_2^+(1-)(0,0)$ band system are computed. The programs are structured so as to permit the limit condition B=0.

Tables of number densities and emission coefficients as

printed directly from the computer are given below for seed ratios B=0, 10^{-4}, $5x10^{-4}$, 10^{-3}, $5x10^{-3}$, 10^{-2} and $5x10^{-2}$. In addition, similar data were obtained for the specific values of B used in all of the experiments but for reasons of space the results are not included in tabular form (see Fig. 8). The computed emission coefficients have been successfully compared with the graphical data presented in AEDC-TR-68-217 as a check against the hand computations made previously.

In the case of air, where ionization of the atomic species of nitrogen and oxygen were neglected in the computation of the electron densities, accurate results cannot be expected at temperatures above about 6000°K. The limit of this assumption is demonstrated by the fact that the computed total number density of ions, NI, is not equal to the number density of electrons, NE, at temperatures above about 5800°K as it should be under conditions of single ionization. Because of the limited validity of this assumption in the air program, convergence of the volume seed ratio, A, at the highest temperatures was not always attained.

Data formats for the two programs are given below.

DATA FORMAT

Data Set		Information	Card Format
1.		B,PT,ITMNS, ITMXS, ITDLS	2F7.4, 3IA
2.		S(K)	8E10.4
3.	(DOSNIP)	ITS, Z(ITS,J)J=1,6	I3,2E7.4,F5.4,F1.0,E7.4,F5.4
	(DOSNOP)	ITS, Z(ITS,J)J=1,12	I3,2E7.4,F5.4,F1.0,3(E7.4,F5.4)
4.		EL(LL), LL=1,NGE	12F6.0
5.		G(LL),LL=1,NGE	12F6.0
6.		B,PT (new set)	2F7.4

Data Set 1.

This set consists of one card containing the mass seed ratio, B, the total pressure, PT, the minimum integer temperature, ITMS,

the maximum integer temperature, ITMXS, and the integer temperature increment, ITDLS. The temperature integers are expressed in units of T/100.

Data Set 2.

This set contains the strength factors for the twenty-six P-branch components of the molecular band which have been pre-calculated from

$$S(K) = \frac{2(K+1)}{\lambda_K^4}\left[1 - \frac{1}{(2K+1)(2K+3)}\right]\beta_K$$

when β_K is the symmetry factor which is 1 for odd K and $\frac{1}{2}$ for even K where K represents the upper rotational quantum number. This set is punched eight to a card and consists of a total of 3 cards.

Data Set 3.

This set consists of one card per temperature which contains the integer temperature (ITS) and all of the partition functions in the order of increasing subscript. The set will consist of a total of $\left(\frac{\text{ITMXS - ITMNS}}{\text{ITDLS}}+1\right)$. The only difference in the format for the two programs is in this card which contains only six Z(ITS,J) values for DOSNIP and twelve for DOSNOP.

Data Set 4.

The energy levels for the potassium atom are contained on this card with twelve per card and a total number NGE=111 or a total of ten cards to the set.

Data Set 5.

This set contains the statistical weights of the energy levels of set 4 in a one to one correspondence, i.e., twelve to the card and ten cards in the same order as Set 4. The numerical values for EL, and G were taken from NBS Circular 467 with the missing levels included.

Data Set 6.

If computations at more than one seed ratio and/or total pressure are required each new set of these two parameters is included on one card. This set consists of as many cards as there are new combinations

of the two parameters. After the last computation the end of file card, which is the last card of the program deck, will be read to transfer the program to EXIT.

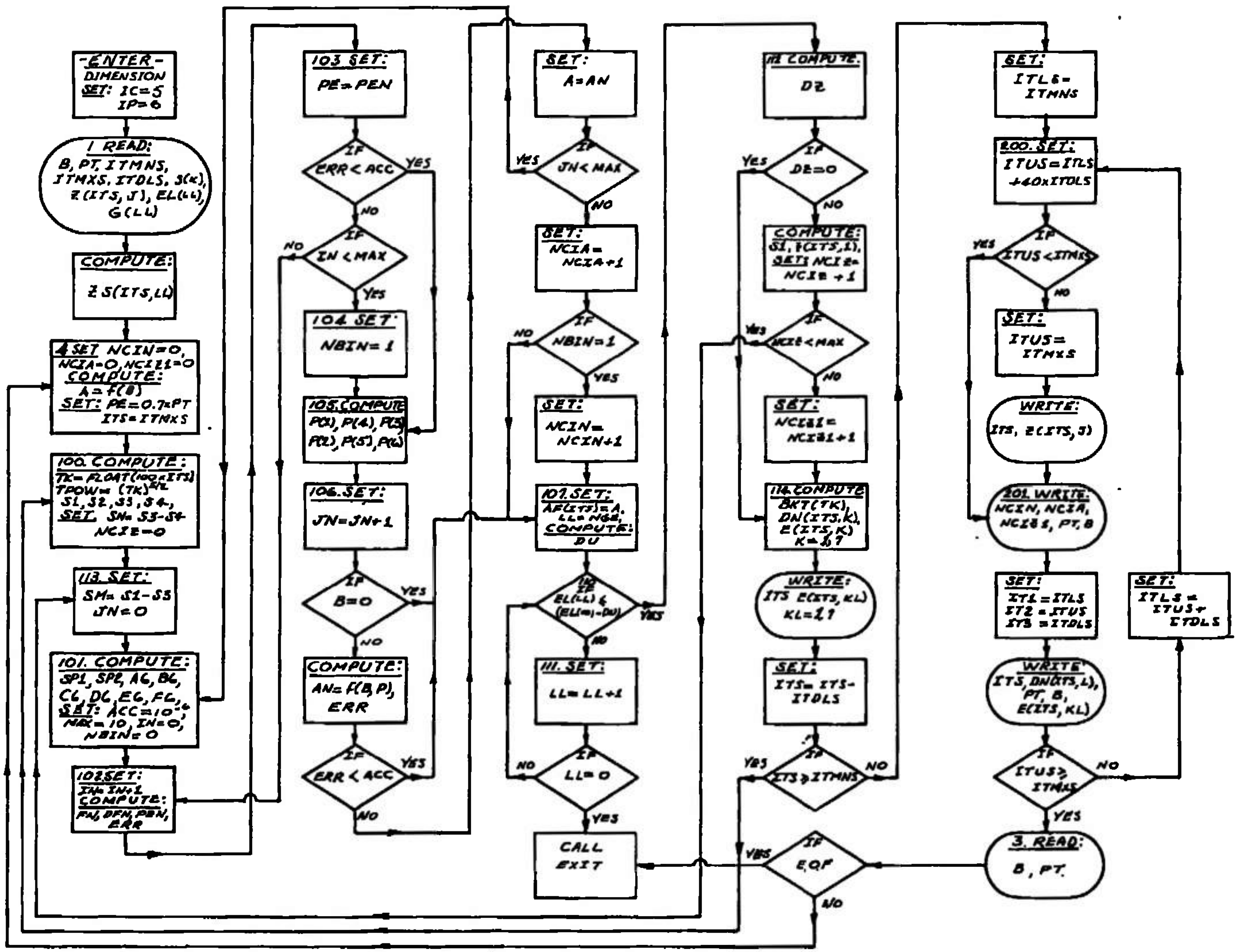

Fig. A-I Flow Diagram for DOSNIP Computer Program

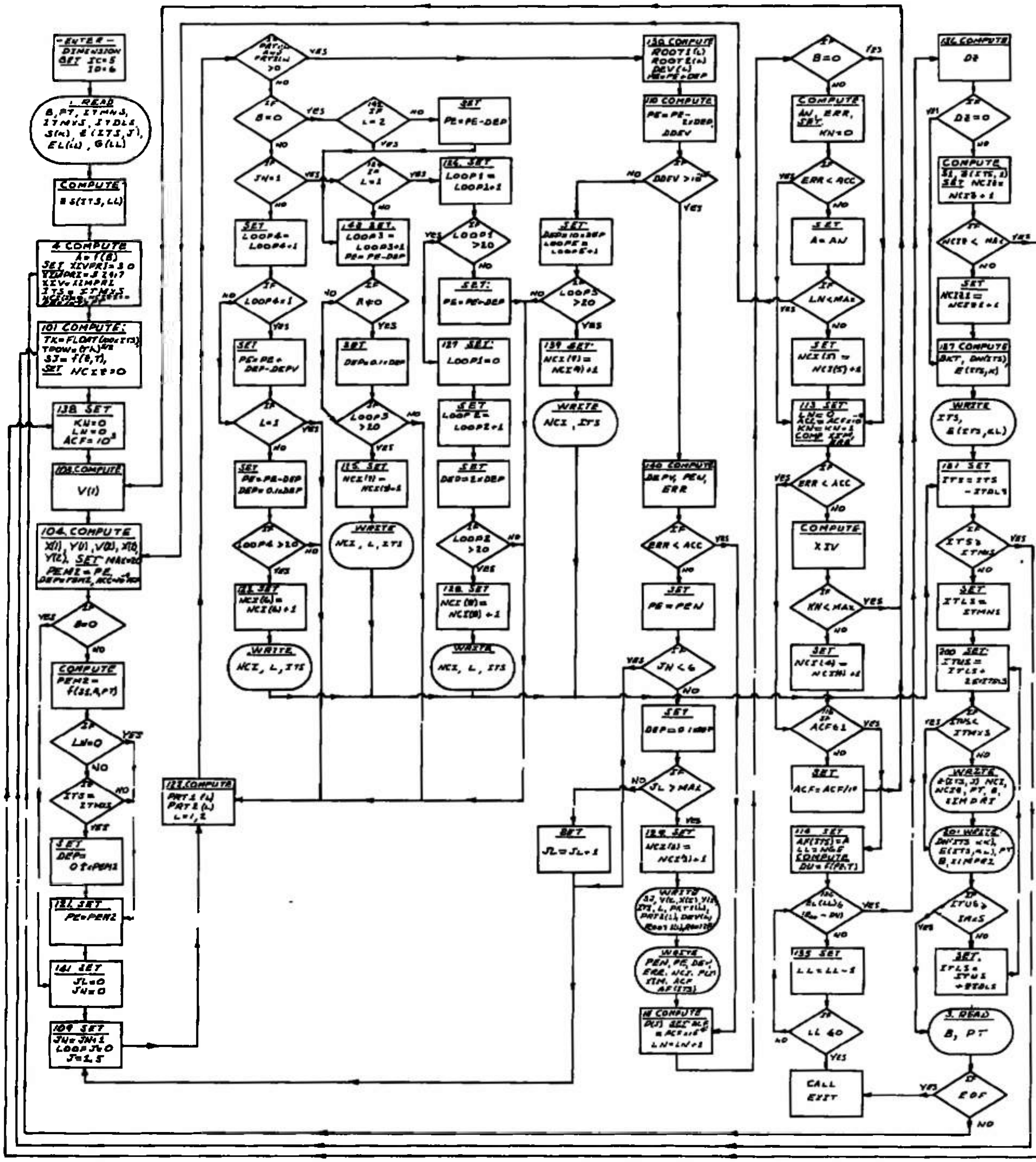

Fig. A-II Flow Diagram for DOSNOP Computer Program

Table AI. Computed plasma composition of air at one atmosphere converted from data of Hilsenrath (Ref. 4.)

T	N2	N	N2+	N+	O2	O	O2+	O+	NO	NO+	E-
2000	2.850E 18	2.916E 09	4.114E-07	0.	7.527E 17	1.109E 15	1.584E 01	3.174E-06	3.035E 16	3.537E 06	3.509E 06
2200	2.581E 18	3.658E 10	1.081E-04	3.896E-10	6.739E 17	4.046E 15	6.873E 02	1.180E-03	4.467E 16	5.289E 07	5.228E 07
2399	2.353E 18	2.984E 11	1.124E-02	2.276E-07	6.032E 17	1.174E 15	1.578E 04	1.625E-01	6.070E 16	5.021E 08	4.942E 08
2600	2.155E 18	1.750E 12	5.756E-01	4.995E-05	5.353E 17	2.644E 16	2.207E 05	1.041E 01	7.735E 16	3.354E 09	3.289E 09
2799	1.977E 18	7.935E 12	1.698E 01	5.175E-03	4.665E 17	3.819E 16	2.078E 06	3.704E 02	9.296E 16	1.697E 10	1.658E 10
3000	1.815E 18	2.930E 13	3.234E 02	2.960E-01	3.929E 17	1.105E 17	1.405E 07	8.203E 03	1.055E 17	6.851E 10	6.679E 10
3200	1.663E 18	9.118E 13	4.327E 03	1.034E 01	3.141E 17	1.821E 17	7.105E 07	1.208E 05	1.129E 17	2.275E 11	2.215E 11
3399	1.524E 18	2.465E 14	4.352E 04	2.420E 02	2.334E 17	2.682E 17	2.761E 08	1.262E 06	1.134E 17	6.300E 11	6.219E 11
3599	1.399E 18	5.928E 14	3.482E 05	4.086E 03	1.589E 17	3.554E 17	8.442E 08	9.830E 06	1.066E 17	1.547E 12	1.510E 12
3800	1.293E 18	1.295E 15	2.314E 06	5.263E 04	9.872E 16	6.164E 17	2.087E 09	5.963E 07	9.427E 16	3.306E 12	3.236E 12
4000	1.205E 18	2.631E 15	1.328E 07	5.579E 05	5.707E 16	4.998E 17	4.295E 09	2.978E 08	7.941E 16	6.375E 12	6.266E 12
4199	1.133E 18	4.999E 15	6.641E 07	4.837E 06	3.176E 16	4.986E 17	7.708E 09	1.245E 09	6.498E 16	1.130E 13	1.115E 13
4400	1.071E 18	8.955E 15	2.924E 08	3.485E 07	1.753E 16	5.041E 17	1.254E 10	4.490E 09	5.249E 16	1.876E 13	1.856E 13
4600	1.016E 18	1.522E 16	1.144E 09	2.129E 08	9.782E 15	4.992E 17	1.901E 10	1.434E 10	4.230E 16	2.951E 13	2.928E 13
4799	9.642E 17	2.467E 16	4.016E 09	1.121E 09	5.578E 15	4.882E 17	2.737E 10	4.135E 10	3.416E 16	4.443E 13	4.419E 13
4999	9.130E 17	3.837E 16	1.279E 10	5.177E 09	3.259E 15	4.735E 17	3.787E 10	1.091E 11	2.801E 16	6.445E 13	6.424E 13
5200	8.610E 17	5.734E 16	3.711E 10	2.121E 10	1.953E 15	4.571E 17	5.068E 10	2.667E 11	2.282E 16	9.033E 13	9.029E 13
5400	8.066E 17	8.268E 16	9.914E 10	7.809E 10	1.196E 15	4.392E 17	6.594E 10	6.091E 11	1.862E 16	1.228E 14	1.232E 14
5599	7.485E 17	1.156E 17	2.465E 11	2.655E 11	7.527E 14	4.201E 17	8.369E 10	1.317E 12	1.525E 16	1.622E 14	1.637E 14
5800	6.858E 17	1.568E 17	5.726E 11	8.387E 11	4.870E 14	4.000E 17	1.038E 11	2.714E 12	1.248E 16	2.083E 14	2.120E 14
6000	6.182E 17	2.061E 17	1.238E 12	2.428E 12	3.192E 14	3.790E 17	1.257E 11	5.312E 12	1.016E 16	2.601E 14	2.686E 14
6199	5.465E 17	2.626E 17	2.493E 12	6.487E 12	2.113E 14	3.573E 17	1.489E 11	9.916E 12	8.204E 15	3.149E 14	3.335E 14
6400	4.721E 17	3.241E 17	4.670E 12	1.600E 13	1.408E 14	3.352E 17	1.723E 11	1.768E 13	6.544E 15	3.692E 14	4.075E 14
6599	3.971E 17	3.882E 17	8.119E 12	3.650E 13	9.411E 13	3.132E 17	1.940E 11	3.009E 13	5.152E 15	4.181E 14	4.931E 14
6799	3.244E 17	4.510E 17	1.305E 13	7.695E 13	6.319E 13	2.919E 17	2.133E 11	4.893E 13	3.998E 15	4.544E 14	5.944E 14
7000	2.568E 17	5.090E 17	1.936E 13	1.511E 14	4.323E 13	2.719E 17	2.277E 11	7.613E 13	3.072E 15	4.720E 14	7.209E 14

Table AII. DOSNIP Fortran IV Program

```
      PROGRAM DOSNIP(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,PUNCH)
C           DIAGNOSIS OF POTASSIUM SEEDED NITROGEN PLASMAS
C     DOSNIP ... CDC 6600 VERSION
      DIMENSION AF(100),DN(100,9),P(6),Z(100,6),S(26),E(100,7)
     1,EL(111),G(111),ZS(100,111)
C     (IC) IS CODE FOR CARD INPUT, (IP) IS CODE FOR PRINTER OUTPUT.
      IC=5
      IP=6
C     ENTER VALUE FOR EQUILIBRIUM CONCENTRATION OF SEED BY WEIGHT,(B),
C     TOTAL PRESSURE (P), AND THE LOWEST,THE HIGHEST,AND THE INCREMENT
C     OF TEMPERATURE TO BE USED FOR COMPUTATION. B IS ENTERED AS X.XXX,
C     P AS Y.YYYY, AND TEMPERATURES AS ZZZZZ - ALL ON SAME DATA CARD.
    1 READ(IC,1000)B,PT,ITMNS,ITMXS,ITDLS
C     ENTER TABLE OF PARTITION FUNCTIONS (Z). THERE ARE SIX VALUES AND
C     THE TEMPERATURE ON ONE CARD AS T,Z(1) THRU Z(6) PER FORMAT 1001.
      READ(IC,1113) (S(K),K=1,26)
      DO 2 L=ITMNS,ITMXS,ITDLS
      READ(IC,1001)ITS,(Z(ITS,J),J=1,6)
    2 CONTINUE
      NGE=111
      READ(IC,1116) (EL(LL) ,LL=1,NGE)
      READ(IC,1116) (G(LL) ,LL=1,NGE)
      DO 5 ITS=ITMNS,ITMXS,ITDLS
      ZS(ITS,1)=2.
      T=FLOAT(100*ITS)
      DO 5 LL=2,NGE
      ZT=G(LL)*EXP(-1.438864*EL(LL)/T)
      ZS(ITS,LL)=ZS(ITS,LL-1)+ZT
 5    CONTINUE
      GOTO4
    3 READ(IC,1002)B,PT
      IF(EOF,5)2n3,4
    4 NCIN=0
      NCIA=0
      NCIZ1=0
      A=B/(1.395488-0.395488*B)
      PE=0.7*PT
      ITS=ITMXS
  100 TK=FLOAT(100*ITS)
      TPOW=SQRT(TK**5)
      S1=(6.58014E-7*TPOW*Z(ITS,4)/Z(ITS,1)*EXP(-5.03733E4/TK))
      S2=(4.74455E-1*TPOW*((Z(ITS,3))**2)/Z(ITS,2)*EXP(-1.132457E5/TK))
      S3=(6.58014E-7*TPOW*Z(ITS,5)/Z(ITS,2)*EXP(- 1.808027E5/TK))
      S4=(6.58014E-7*TPOW*Z(ITS,6)/Z(ITS,3)*EXP(-1.688402E5/TK))
      SN=S3-S4
      NCIZ=0
 113  SM=S1-S3
      JN=0
  101 SP1=A*SM*PT
      SP2=S2*SN
      A6=2.*(S1+2.*S3)
      B6=S1*(S1+8.*S3)+2.*S3*(2.*S3-PT)-(2.*SP1+SP2)
      C6=2.*S1*(2.*S3*(2.*S3-PT)-(SP1+SP2))+2.*S2*(SN**2)+(2.*S3*(2.*(S1
     1**2-S3*PT-SP1)-SP2))
      D6=(S1**2)*(2.*S3*(2.*S3-PT)-SP2)+(S3**2)*PT*(PT-8.*S1)+SP1**2+S2*
     2SN*(A*PT*(S1-S4)+SN*(4.*S1-PT))+S3*(PT*(2.*SP1+SP2)-4.*S1*(SP1+SP2
     3))
```

```
      E6=2.*((S1**2)*SP2*(-S4)+(S3**2)*S1*PT*(PT-2.*S1))+S1*PT*SP2*(A*(
     4S1-S4)-2.*SN)+2.*S1*S3*PT*(SP1+SP2)
      F6=(S1**2)*PT*((S3**2)*PT+S4*SP2)
C     SOLUTION OF A SIXTH DEGREE POLYNOMIAL IN PE BY NEWTON-RAPHSON
C     METHOD. ENTER RATIO OF ALLOWABLE DEVIATION FROM ACTUAL VALUE TO
C     ACTUAL VALUE (ACC) AS X.E-XX
      ACC=1.E-6
C     ENTER MAXIMUM ALLOWABLE NUMBER OF ITERATIONS (MAX) AS YYY
      MAX=10
      IN=0
      NBIN=0
  102 IN=IN+1
      FN=(PE**6)+A6*(PE**5)+B6*(PE**4)+C6*(PE**3)+D6*(PE**2)+E6*PE+F6
      DFN=6.*(PE**5)+5.*A6*(PE**4)+4.*B6*(PE**3)+3.*C6*(PE**2)+2.*D6*PE+
     5E6
      PEN=PE-FN/DFN
      ERR=ABS((PE-PEN)/PEN)
  103 PE=PEN
      IF(ERR.LT.ACC)GOTO105
      IF(IN.LT.MAX)GOTO102
  104 NBIN=1
  105 P(1)=PE*A*PT/(PE+S1)
      P(4)=P(1)*S1/PE
      P(3)=(-S2+SQRT(S2**2+4.*S2*(PT-2.*PE-P(1))))/2.
      P(2)=(P(3)**2)/S2
      P(5)=P(2)*S3/PE
      P(6)=P(3)*S4/PE
C     RECALCULATION OF CONCENTRATION OF SEED BY VOLUME (A) USING PARTIAL
C     PRESSURES CALCULATED WITH ASSUMED VALUE. ENTER DESIRED VALUE OF
C     ACC AND MAX AS BEFORE.
  106 JN=JN+1
      IF(B.EQ.0) GO TO 107
      AN=.716595*(B/(1.-B))*(P(2)+P(5)+(P(3)+P(6))/2.)/PT
      ERR=ABS((A-AN)/AN)
      IF(ERR.LT.ACC)GOTO107
      A=AN
      IF(JN.LT.MAX)GOTO101
      NCIA=NCIA+1
      IF(NBIN.EQ.1)NCIN=NCIN+1
  107 AF(ITS)=A
      LL=NGE
      DU=1.4428987E7*SQRT(2.*PE)/TK
 110  IF(EL(LL)-3.500978E4+DU) 112,112,111
 111  LL=LL-1
      IF(LL) 203,203,110
 112  DZ=Z(ITS,1)-ZS(ITS,LL)
      IF(DZ.EQ.0.0) GO TO 114
      S1=S1*Z(ITS,1)/ZS(ITS,LL)
      Z(ITS,1)=ZS(ITS,LL)
      NCIZ=NCIZ +1
      IF(NCIZ.LT.MAX) GO TO 113
      NCIZ1=NCIZ1+1
 114  BKT=1.362374E-22*TK
      DO 108 K=1,6
      DN(ITS,K)=P(K)/BKT
  108 CONTINUE
      DN(ITS,7)=PE/BKT
      DN(ITS,8)=(PE+P(1)+P(2)+P(3)+P(4)+P(5)+P(6))/BKT
```

```
      DN(ITS,9)=DN(ITS,4)+DN(ITS,5)+DN(ITS,6)
      E(ITS,1)=8.25766E-14*DN(ITS,1)*EXP(-4.7737E4/TK)/Z(ITS,1)
      E(ITS,2)=5.76556E-14*DN(ITS,1)*EXP(-4.34307E4/TK)/Z(ITS,1)
      E(ITS,3)=2.70888E-13*DN(ITS,1)*EXP(-3.94960E4/TK)/Z(ITS,1)
      E(ITS,4)=1.01299E-13*DN(ITS,3)*EXP(-1.53206E5/TK)/Z(ITS,3)
      E(ITS,5)=1.36418E-12*DN(ITS,3)*EXP(-1.39210E5/TK)/Z(ITS,3)
      E(ITS,6)=5.41E-46*DN(ITS, 7)**3/(DN(ITS, 9)*TK**0.5)
      SUM=0.0
      DO133K=1,26
      SUM=SUM+S(K)*EXP(2.983075*FLOAT(K-K**2)/TK)
  133 CONTINUE
      E(ITS,7)=6.742995E-31*DN(ITS,5)*EXP(-3.66357E4/TK)*SUM/Z(ITS,5)
      IF(ITS.EQ.100)
     1WRITE(IP,1007)
      WRITE(IP,1115) ITS,(E(ITS,KL),KL=1,7)
      ITS=ITS-ITDLS
      IF(ITS.GE.ITMNS)GOTO100
      ITLS=ITMNS
  200 ITUS=ITLS+40*ITDLS
      IF(ITUS.LT.ITMXS)GOTO201
      ITUS=ITMXS
      WRITE(IP,1006)
      WRITE(IP,1005)(ITS,(Z(ITS,J),J=1,6),ITS=ITMNS,ITMXS,ITDLS)
  201 WRITE(IP,1003)NCIN,NCIA,NCIZ1,PT,B
      IT1=ITLS
      IT2=ITUS
      IT3=ITDLS
      WRITE(IP,1004)(ITS,(DN(ITS,L),L=1,8),AF(ITS),ITS=IT1,IT2,IT3)
      WRITE(IP,1114)PT,B
      WRITE(IP,1115)(ITS,(E(ITS,KL),KL=1,7),ITS=IT1,IT2,IT3)
      IF(ITUS.GE.ITMXS)GOTO202
      ITLS=ITUS+ITDLS
      GOTO200
  202 GOTO3
  203 CALL EXIT
 1000 FORMAT(2F7.4,3(I4,2X))
 1001 FORMAT(I3,2X,2E7.4,F5.4,F1.0,E7.4,F5.4)
 1002 FORMAT(2F7.4)
 1003 FORMAT(1H1//48X,25HPARTICLE NUMBER DENSITIES,35X,3I4/46X,29H- POT
     1ASSIUM SEEDED NITROGEN -/47X,16HTOTAL PRESSURE =F7.4,4H ATM/54X,3H
     2B =E10.3//5X,4HT(K),6X,2HN1,10X,2HN2,10X,2HN3,10X,2HN4,10X,2HN5,
     310X,2HN6,10X,2HNE,10X,2HNT,10X,1HA/)
 1004 FORMAT(3X,I4,2H00,8E12.4,E11.3)
 1005 FORMAT(3X,I4,2H00,2E12.4,F7.4,F3.0,E12.4,F7.4)
 1006 FORMAT(1H1///3X,25HINPUT PARTITION FUNCTIONS/)
 1007 FORMAT(1H1)
 1113 FORMAT(8E10.4)
 1114 FORMAT(1H1///38X,21HEMISSION COEFFICIENTS
     1 /34X,29H- POTASSIUM SEEDED NITROGEN -/35X,16HTOTAL PRESSURE =F7.4
     2,4H ATM/42X,3HB =E10.3
     3 //5X,4HT(K),3X,7HE4965KI,5X,7HE5832KI,5X,7HE6936KI,5X,7HE4935NI,
     45X,7HE7469NI,6X,6HE5600C,5X,8HE3914N2+/)
 1115 FORMAT(3X,I4,2H00,7E12.4)
 1116 FORMAT(12F6.0)
C     IF DIGITS APPEAR IN UPPER RIGHT HAND CORNER OF OUTPUT PAGE
C     DIRECTLY ABOVE (A) NEWTON LOOP DID NOT CONVERGE WITHIN ACC. IF
C     DIGITS APPEAR ABOVE AND TO RIGHT OF (A) VOLUME RATIO LOOP DID NOT
C     CONVERGE WITHIN ACC.
      END
```

```
0.0052  1.      2000 10000   200

.8464E+171.5931E+181.2430E+183.3563E+182.1092E+185.0760E+182.9656E+186.7850E+18
.8189E+188.4899E+184.6710E+181.0194E+195.5230E+181.1898E+196.3756E+181.3605E+19
.2296E+181.5314E+198.0853E+181.7028E+198.9433E+181.8747E+199.8042E+182.0472E+19
.0669E+192.2205E+19

200020000E043307E240000193201E284478
220020000E049572E240000110753E384963
240020000E056270E240001112321E385371
260020000E063404E240002114036E385721
280020000E070979E240005115910E386028
300020000E078997E240010117955E386299
320020000E087463E240018120185E386546
340020000E096378E240030122610E386772
360020000E010575E340047125243E386985
380020000E011557E340070128095E387188
400020000E012585E340101131177E387384
420020000E013660E340141134499E387576
440020000E014781E340191138072E387767
460020000E015948E340252141904E387958
480020000E017163E340325146007E388151
500020000E018425E340410150388E388346
520020000E019735E340510155057E388545
540020000E021092E340623160022E388747
560020000E022498E340752165292E388954
580020000E023952E340895170875E389166
600020000E025456E341054176780E389363
620020000E027009E341228183015E389604
640020000E028611E341418189589E389830
660020000E030265E341624196509E390061
680020000E031969E341845110378E490297
700020000E033724E342081111142E490537
720020000E035532E342333111943E490781
740020000E037393E342599112783E491030
760020000E039308E342880113661E491282
780020000E041278E343175114579E491538
800020000E043305E343484115538E491797
820020000E045388E343807116539E492059
840020000E047531E344142117583E492324
860020000E049734E344490118671E492592
880020000E051999E344850119803E492863
900020000E054328E345222120982E493136
920020000E056724E345604122207E493411
940020000E059188E345998123480E493688
960043442E161723E346401124802E493967
980020000E064333E346815126175E494247
000020000E067019E347237127599E494529
```

```
00000 12985 13043 21027 21535 24701 24720 27397 27398 27451 28128 28999
29008 30185 30274 30606 30620 31070 31074 31696 31765 31953 31961 32227
32230 32598 32648 32765 32940 32942 33178 33214 33291 33410 33411 33572
33598 33652 33737 33852 33870 33972 34057 34069 34148 34283 34388 34472
34540 34596 34643 34681 34715 34743 34768 34789 34808 34824 34838 34851
34863 34873 34882 34890 34898 34905 34911 34917 34922 34926 34931 34935
34939 34942 34945 34948 34951 34954 34956 34958 34961 34963 34965 34966
34968 34970 34971 34973 34973 34975 34976 34978 34979 34980 34981 34982
34982 34983 34984 34985 34986 34986 34987 34988 34988 34989 34989 34990
34991 34991 34991
    2     2     4     2    10     2     4     6     4     4    14     4
    4    10     2    14    18     2     4    10     2    14    40     2
    4    10     2    80     2     4    10     2   110     2     4    10
    2   144     6   392     2   286   234     2   336   392   450   512
  578   648   722   800   882   968  1058  1152  1250  1352  1458  1568
 1682  1800  1922  2048  2178  2312  2450  2592  2738  2888  3042  3200
 3362  3528  3698  3872  4050  4232  4418  4608  4802  5000  5202  5408
 5618  5832  6050  6272  6498  6728  6962  7200  7442  7688  7938  8192
 8450  8712  8978  9248  9522  9800 10082 10368 10658 10952 11250 11552
11858 12168 12482
0.00330    1.0
```

Table AIII. DOSNOP Fortran IV Program

```
      PROGRAM DOSNOP(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
C           DIAGNOSIS OF POTASSIUM SEEDED NITROGEN/OXYGEN PLASMAS
C     DOSNOP ... CDC 6600 VERSION
      DIMENSION AF(070),DEV(2),DN(070,15),NCI(9),P(12),       V(2),X(2),
     1Y(2),Z(070,12),E(070,7),PRT1(2),PRT2(2),ROOT1(2),ROOT2(2),S(26)
     2,EL(111),G(111),ZS(70,111)
C     IC IS CODE FOR CARD INPUT, IP IS CODE FOR PRINTER OUTPUT
      IC=5
      IP=6
C     ENTER VALUE FOR EQUILIBRIUM CONCENTRATION OF SEED BY WEIGHT (B),
C     TOTAL PRESSURE (P), AND THE LOWEST, THE HIGHEST, AND THE INCREMENT
C     OF TEMPERATURE TO BE USED FOR COMPUTATION. B IS ENTERED AS X.XXX,
C     P AS Y.YYYY, AND TEMPERATURES AS ZZZZZ, ALL ON SAME DATA CARD.
    1 READ(IC,1000)B,PT,ITMNS,ITMXS,ITDLS
C     ENTER TABLE OF PARTITION FUNCTIONS (Z). THERE ARE TWELVE VALUES
C     AND THE TEMPERATURE PER CARD AS Z(1 THRU 12) IN FORMAT 1001.
      READ(IC,1113) (S(K),K=1,26)
   10 DO 2 L=ITMNS,ITMXS,ITDLS
      READ(IC,1001)ITS,(Z(ITS,J),J=1,12)
    2 CONTINUE
      NGE=111
      READ(IC,1116) (EL(LL) ,LL=1,NGE)
      READ(IC,1116) (G(LL) ,LL=1,NGE)
      DO 5 ITS=ITMNS,ITMXS,ITDLS
      ZS(ITS,1)=2.
      T=FLOAT(100*ITS)
      DO 5 LL=2,NGE
      ZT=G(LL)*EXP(-1.438864*EL(LL)/T)
      ZS(ITS,LL)=ZS(ITS,LL-1)+ZT
 5    CONTINUE
      GOTO4
    3 READ(IC,1002)B,PT
      IF(EOF,5)203,4
    4 DO 100 J=1,8
      NCI(J)=0
  100 CONTINUE
      A=B/(1.3448-0.3448*B)
C     ENTER EQUILIBRIUM RATIO OF NITROGEN PARTIAL PRESSURES TO OXYGEN
C     PARTIAL PRESSURES BY VOLUME (XIVPRI) AND BY MASS (XIMPRI)
      XIVPRI=3.0
      XIMPRI=3.2917
      XIV=XIVPRI
      NCIZ1=0
      ITS=ITMXS
      PE=1.E-4*PT
  101 TK=FLOAT(100*ITS)
      TPOW=SQRT (TK**5)
      S1=(6.58014E-7*TPOW*Z(ITS,4)/Z(ITS,1))*EXP (-5.03733E4/TK)
      S2=(4.74455E-1*TPOW*(Z(ITS,3)**2)/Z(ITS,2))*EXP (-1.132457E5/TK)
      S3=(6.58014E-7*TPOW*Z(ITS,5)/Z(ITS,2))*EXP (-1.808027E5/TK)
      S4=(6.58014E-7*TPOW*Z(ITS,6)/Z(ITS,3))*EXP (-1.688402E5/TK)
      S5=(5.79673E-1*TPOW*(Z(ITS,8)**2)/Z(ITS,7))*EXP (-5.9368E4/TK)
      S6=(6.58014E-7*TPOW*Z(ITS,9)/Z(ITS,7))*EXP (-1.41795E5/TK)
      S7=(6.58014E-7*TPOW*Z(ITS,10)/Z(ITS,8))*EXP (-1.58037E5/TK)
      S8=(5.22682E-1*TPOW*Z(ITS,3)*Z(ITS,8)/Z(ITS,11))*EXP(-7.5506E4/TK)
      S9=(6.58014E-7*TPOW*Z(ITS,12)/Z(ITS,11))*EXP (-1.07445E5/TK)
      NCIZ=0
```

```
 138  KN=0
  102 LN=0
C     ACF IS THE ACCURACY CORRECTION FACTOR USED TO REDUCE THE NUMBER OF
C     ITERATIONS REQUIRED IN EARLY TRIALS. ACCURACY REQUIREMENTS TO
C     LIMIT WITH SUCCESSFUL TRIALS. ENTER ACF AS X.EYY, YY GT OR EQ ZERO
      ACF=1.E3
  103 V(1)=S1+(1.+XIV)*S9
  104 X(1)=(1.+XIV)*(S1-S2/4.)*S9-(A*S1+XIV*(1.+A)*S9)*PT
      Y(1)=((A*XIV-XIV-A)*PT-(1.+XIV)*S2/4.)*S1*S9
      V(2)=S1+(1.+XIV)*S9/XIV
      X(2)=((1.+XIV)*(S1-S5/4.)*S9-(A*XIV*S1+S9+A*S9)*PT)/XIV
      Y(2)=((A-A*XIV-1.)*PT-(1.+XIV)*S5/4.)*S1*S9/XIV
C     TOLERANCE (RATIO OF DEVIATION TO VALUE) (ACC) AS X.E-XX
      ACC=ACF*1.E-9
C     ENTER MAXIMUM ALLOWABLE ITERATIONS IN ONE CONVERGENCE (MAX) AS YYY
      MAX=20
C     DETERMINATION OF NEW TRIAL VALUE OF PE USING INCREMENTAL SLOPE
C     APPROACH TO NEWTON-RAPHSON.
      DEP=0.1*PE
      IF(B.EQ.0) GO TO 141
      PEM2=(-S1+(S1**2+4.*A*PT*S1)**0.5)/2.
      IF(LN.NE.0)GO TO 121
      IF(ITS.EQ.ITMXS)
     1DEP=0.1*PEM2
  121 PE=PEM2
  141 JL=0
      JN=0
  109 JN=JN+1
      LOOP1=0
      LOOP2=0
      LOOP3=0
      LOOP4=0
      LOOP5=0
  122 DO 110 L=1,2
      PRT1(L) =     (-4.*S2*(PE**3+PE**2*V(1)+PE*X(1)+Y(1))
     1  /(S9*(PE+S1)*(1.+XIV)))                                         05/09/69
      PRT2(L) =     (-4.*S5*XIV*(PE**3+PE**2*V(2)+PE*X(2)+Y(2))
     1  /(S9*(PE+S1)*(1.+XIV)))                                         05/09/69
      IF(PRT1(L).GT.0.0.AND.PRT2(L).GT.0.0)GOTO130
      IF(B.EQ.0) GO TO 142
      IF(JN.EQ.1)GOTO124
      LOOP4=LOOP4+1
      IF(LOOP4.EQ.1)
     1PE=PE+DEP-DEPV
      IF(L.EQ.1)GO TO 122
      PE=PE-DEP
      DEP=0.1*DEP
      IF(LOOP4.GT.20)GOTO123
      GOTO122
  123 NCI(6)=NCI(6)+1
      WRITE (IP,2007)NCI,L,ITS
      GO TO 131
  142 IF(L.EQ.2) PE=PE-DEP
      GO TO 143
  124 IF(L.EQ.1)GO TO 126
  143 LOOP3=LOOP3+1
      PE=PE-DEP
      IF(B.NE.0)
```

```
      1DEP=0.1*DEP
       IF(LOOP3.GT.20)GO TO 125
       GO TO 122
 125   NCI(7)=NCI(7)+1
       WRITE(IP,1100)S1,S2,S3,S4,S5,S6,S7,S8,S9
       WRITE(IP,1101)((I,V(I),I,X(I),I,Y(I)),I=1,2)
       WRITE (6,2000)ITS,L,PRT1(L),PRT2(L)
       WRITE(IP,1105)L,DEV(L),ROOT1(L),ROOT2(L),DEP
       WRITE (IP,2006)ERR,PEN,PE,NCI,ITS
       WRITE(IP,1106)((I,P(I)),I=1,12)
       WRITE(IP,1107)XIV
       WRITE(IP,1109)ACF
       WRITE(IP,1110)ITS,AF(ITS)
       WRITE (IP,2008)NCI,L,ITS
       GO TO 131
 126   LOOP1=LOOP1+1
       IF(LOOP1.GT.20 )GO TO 127
       PE=PE+DEP
       GO TO 122
 127   LOOP1=0
       LOOP2=LOOP2+1
       DEP=2.0*DEP
       IF(LOOP2.GT.20)GO TO 128
       GO TO 122
 128   NCI(8)=NCI(8)+1
       WRITE (IP,2009)NCI,L,ITS
       GO TO 131
 130   CONTINUE
       ROOT1(L)=SQRT(PRT1(L))
       ROOT2(L)=SQRT(PRT2(L))
       DEV(L)=(-S2+ROOT1(L))*(-S5+ROOT2(L))/4.-S8*PE*(PE**2+PE*S1-A*PT*S1
      1 )/(S9*(PE+S1))
       PE=PE+DEP
  110  CONTINUE
       PE=PE-2.*DEP
       DDEV=ABS(DEV(1)-DEV(2))
       IF(DDEV.GT.1.E-15) GOTO 140
       DEP=10.0*DEP
       LOOP5=LOOP5+1
       IF(LOOP5.GT.MAX) GOTO 139
       GOTO 122
 139   NCI(9)=NCI(9)+1
       WRITE(IP,2010) NCI,ITS
       GO TO 131
 140   DEPV=  DEP*DEV(1)/(DEV(1)-DEV(2))
       PEN=PE+DEPV
       ERR=ABS((PE-PEN)/PEN)
       IF(ERR.LT.ACC)GOTO111
       PE=PEN
       IF(JN.LT.6) GO TO 109
       DEP=0.1*DEP
       IF(JL.GT.MAX)GOTO129
       JL=JL+1
       GOTO109
 129   NCI(3)=NCI(3)+1
  111  P(3)=(-S2+ROOT1(1))/2.
       P(8)=(-S5+ROOT2(1))/2.
       P(1)=A*PT*PE/(PE+S1)
```

```
      P(2)=P(3)**2/S2
      P(4)=P(1)*S1/PE
      P(5)=P(2)*S3/PE
      P(6)=P(3)*S4/PE
      P(7)=P(8)**2/S5
      P(9)=P(7)*S6/PE
      P(10)=P(8)*S7/PE
      P(11)=P(3)*P(8)/S8
      P(12)=P(11)*S9/PE
C     APT CALC. LATER
C     RECALCULATION OF CONCENTRATION OF SEED BY VOLUME (A) USING PARTIAL
C     PRESSURES CALCULATED.
  112 ACC=ACF*1.E-4
      LN=LN+1
      IF(B.EQ.0.0) GO TO 113
      AN=B/(PT*(1.-B))*(.716545*(P(2)+P(5)+(P(3)+P(6))/2.)+.818498*(P(7)
     4+P(9)+(P(8)+P(10))/2.)+.767547*(P(11)+P(12)))
      ERR=ABS ((A-AN)/AN)
      KN=0
      IF(ERR.LT.ACC)GOTO113
      A=AN
      IF(LN.LT.MAX)GOTO104
      NCI(5)=NCI(5)+1
  113 LN=0
C     RECALCULATION RATIO OF EQUILIBRIUM RATIO (XIV) USING PARTIAL
C     PRESSURES OBTAINED WITH TRIAL VALUE OF A AND TRIAL VALUE OF XIV,
C     EQUILIBRIUM RATIC .
      ACC=ACF*1.E-4
      KN=KN+1
      XIM=0.875*(2.*(P(2)+P(5))+P(3)+P(6)+P(11)+P(12))/(2.*(P(7)+P(9))
     3+P(8)+P(10)+P(11)+P(12))
      ERR=ABS ((XIMPRI-XIM)/XIMPRI)
      IF(ERR.LT.ACC)GOTO116
      XIV=XIV*XIMPRI/XIM
      IF(KN.LT.MAX)GOTO103
      NCI(4)=NCI(4)+1
  116 IF(ACF.LE.1.)GOTO114
      ACF=ACF/1.E1
      GOTO103
  114 AF(ITS)=A
      LL=NGE
      DU=1.4428987E7*SQRT(2.*PE)/TK
 134  IF(EL(LL)-3.500978E4+DU) 136,136,135
 135  LL=LL-1
      IF(LL) 203,203,134
 136  DZ=Z(ITS,1)-ZS(ITS,LL)
      IF(DZ.EQ.0.0) GO TO 137
      S1=S1*Z(ITS,1)/ZS(ITS,LL)
      Z(ITS,1)=ZS(ITS,LL)
      NCIZ=NCIZ +1
      IF(NCIZ.LT.MAX) GO TO 138
      NCIZ1=NCIZ1+1
 137  BKT=1.362374E-22*TK
      DO 115 M=1,12
      DN(ITS,M)=P(M)/BKT
  115 CONTINUE
      DN(ITS,13)=PE/BKT
      DN(ITS,14)=(PE+P(1)+P(2)+P(3)+P(4)+P(5)+P(6)+P(7)+P(8)+P(9)+P(10)+
```

```
     5P(11)+P(12))/BKT
      DN(ITS,15)=DN(ITS,4)+DN(ITS,5)+DN(ITS,6)+DN(ITS,9)+DN(ITS,10)
     1+DN(ITS,12)
C     APT/BKT
      E(ITS,1)=8.25766E-14*DN(ITS,1)*EXP(-4.7737E4/TK)/Z(ITS,1)
      E(ITS,2)=5.76556E-14*DN(ITS,1)*EXP(-4.34307E4/TK)/Z(ITS,1)
      E(ITS,3)=2.70888E-13*DN(ITS,1)*EXP(-3.94960E4/TK)/Z(ITS,1)
      E(ITS,4)=1.01299E-13*DN(ITS,3)*EXP(-1.53206E5/TK)/Z(ITS,3)
      E(ITS,5)=1.36418E-12*DN(ITS,3)*EXP(-1.39210E5/TK)/Z(ITS,3)
      E(ITS,6)=5.41E-46*DN(ITS,13)**3/(DN(ITS,15)*TK**0.5)
      SUM=0.0
      DO133K=1,26
      SUM=SUM+S(K)*EXP(2.983075*FLOAT(K-K**2)/TK)
  133 CONTINUE
      E(ITS,7)=6.742295E-31*DN(ITS,5)*EXP(-3.66357E4/TK)*SUM/Z(ITS,5)
      IF(ITS.EQ.ITMXS)
     1WRITE(IP,1009)
      WRITE(IP,1115) ITS,(E(ITS,KL),KL=1,7)
  131 ITS=ITS-ITDLS
      IF(ITS.GE.ITMNS)GOTO101
      ITLS=ITMNS
  200 ITUS=ITLS+25*ITDLS
      IF(ITUS.LT.ITMXS)GOTO201
      WRITE(IP,1008)
      WRITE(IP,1007)(ITS,(Z(ITS,J),J=1,12),ITS=ITMNS,ITMXS,ITDLS)
      ITUS=ITMXS
      WRITE(IP,1003)(NCI(II),II=1,9),NCIZ1,PT,XIMPRI,B
  201 WRITE(IP,1004)(ITS,(DN(ITS,JJ),JJ=1,8),ITS=ITLS,ITUS,ITDLS)
      WRITE(IP,1005)
      WRITE(IP,1006)(ITS,(DN(ITS,KK),KK=9,15),AF(ITS),ITS=ITLS,ITUS,
     1ITDLS)
      WRITE(IP,1114)PT,XIMPRI,B
      WRITE(IP,1115)(ITS,(E(ITS,KL),KL=1,7),ITS=ITLS,ITUS,ITDLS)
      IF(ITUS.GE.ITMXS)GOTO3
      ITLS=ITUS+ITDLS
      GOTO200
  203 CALL EXIT
 1000 FORMAT(2F7.4,3(I4,2X))
 1001 FORMAT(I3,2X,2E7.4,F5.4,F1.0,3(E7.4,F5.4),2E7.4)
 1002 FORMAT(2F7.4)
 1003 FORMAT(1H1///43X,25HPARTICLE NUMBER DENSITIES,12X,10I4/33X,44H- PO
     1TASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -/42X,16HTOTAL PRESSURE =F7
     2.4,4H ATM/39X,9HNIT/OXY =F7.4,3X,3HB =E10.3//5X,4HT(K),6X,2HN1,10X
     3,2HN2,10X,2HN3,10X,2HN4,10X,2HN5,10X,2HN6,10X,2HN7,10X,2HN8/)
 1004 FORMAT(3X,I4,2H00,8E12.4)
 1005 FORMAT(1H1
     1          ///5X,4HT(K),6X,                        2HN9,10X,3HN10,9X,3HN11,
     49X,3HN12,9X,2HNE,10X,2HNT,10X,2HNI,10X,1HA/)
 1006 FORMAT(3X,I4,2H00,7E12.4,E11.3)
 1007 FORMAT(3X,I4,2H00,2E12.4,F8.4,F3.0,3(E12.4,F8.4),2E12.4)
 1008 FORMAT(1H1///3X,25HINPUT PARTITION FUNCTIONS/)
 1009 FORMAT(1H1)
 1100 FORMAT(1X,4H S1=E11.4,4H S2=E11.4,4H S3=E11.4,4H S4=E11.4,4H S5=
     1E11.4,4H S6=E11.4,4H S7=E11.4,4H S8=E11.4,4H S9=E11.4)
 1101 FORMAT(1X,2HV(I2,2H)=E11.4,2X,2HX(I2,2H)=E11.4,2X,2HY(I2,2H)=
     1E11.4)
 1105 FORMAT(1X,4HDEV(I2,2H)=E11.4,3E15.5)
 1106 FORMAT(1X, 6(2HP(I2,2H)=E11.4,1X))
```

```
 1107 FORMAT(1X,4HXIV=E11.4)
 1109 FORMAT(1X,30HACF FOR PREVIOUS CALCULATIONS=E7.0)
 1110 FORMAT(1X,2HA(I4,2H)=E11.4)
 1113 FORMAT(8E10.4)
 1114 FORMAT(1H1///38X,21HEMISSION COEFFICIENTS/28X,
     1 44H- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -/35X,16HTOTAL PRES
     2SURE =F7.4,4H ATM/32X,9HNIT/OXY =F7.4,3X,3HB =E10.3
     3 //5X,4HT(K),3X,7HE4965KI,5X,7HE5832KI,5X,7HE6936KI,5X,7HE4935NI,
     45X,7HE7469NI,6X,6HE5600C,5X,8HE3914N2+/)
 1115 FORMAT(      3X,I4,2H00,7E12.4)
 1116 FORMAT(12F6.0)
 2000 FORMAT(*0NEG ROOTS*2I5,2E15.6)
 2006 FORMAT(*0ERR =*E15.5,5X*PEN =*E15.5,5X*PE =*E15.5,5X*NCI =*10I4)
 2007 FORMAT(*0LOOP4 EXIT*10I5)
 2008 FORMAT(*0LOOP3 EXIT*10I5)
 2009 FORMAT(*0LOOP2 EXIT*10I5)
 2010 FORMAT(*0LOOP5 EXIT*10I5)
C     IF DIGITS APPEAR IN UPPER RIGHT HAND CORNER OF OUTPUT PAGE NOT ALL
C     ITERATIONS CONVERGED TO WITHIN SPECIFIED ACCURACY
      END
```

```
 0.0      1       2000  7000    200

 .8464E+171.5931E+181.2430E+183.3563E+182.1092E+185.0760E+182.9656E+186.7850E+18
 .8189E+188.4899E+184.6710E+181.0194E+195.5230E+181.1898E+196.3756E+181.3605E+19
 .2296E+181.5314E+198.0853E+181.7028E+198.9433E+181.8747E+199.8042E+182.0472E+19
 .0669E+192.2205E+19

 200020000E043307E240000193201E28447821947E38526623083E34000042853E386341E2
 220020000E049572E240000110753E38496325573E38567326685E34000049693E398820E2
 240020000E056270E240001112321E38537129514E38601630562E34000057053E311216E3
 260020000E063404E240002114036E38572133784E38631234717E34000064938E312637E3
 280020000E070979E240005115910E38602838396E38657139153E34000073353E314146E3
 300020000E078997E240010117955E38629943364E38680143872E34000082304E315743E3
 320020000E087463E240018120185E38654648702E38700948879E34000191795E317430E3
 340020000E096378E240030122610E38677254425E38720254716E34000110183E419207E3
 360020000E010575E340047125243E38698560547E38738259766E34000211242E421075E3
 380020000E011557E340070128095E38718867083E38755565654E34000412356E423034E3
 400020000E012585E340101131177E38738474049E38772271843E34000613527E425085E3
 420020000E013660E340141134499E38757681459E38788778336E34001014754E427228E3
 440020000E014781E340191138072E38776789327E38805185139E34001616038E429465E3
 460020000E015948E340252141904E38795897669E38821692256E34002317380E431795E3
 480020000E017163E340325146007E38815110650E48838399692E34003318780E434221E3
 500020000E018425E340410150388E38834611583E48855310745E44004520240E436741E3
 520020000E019735E340510155057E38854512568E48872711555E44006121759E439358E3
 540020000E021092E340623160022E38874713607E48890512398E44008023339E442072E3
 560020000E022498E340752165292E38895414699E48908813277E44010424981E444884E3
 580020000E023952E340895170875E38916615848E48927614191E44013226685E447795E3
 600020000E025456E341054176780E38936317053E48946915142E44016528452E450806E3
 620020000E027009E341228183015E38960418317E48966716130E44020330284E453919E3
 640020000E028611E341418189589E38983019640E48987117158E44024732181E457135E3
 660020000E030265E341624196509E39006121023E49007918226E44029834145E460456E3
 680020000E031969E341845110378E49029722468E49029219336E44035536177E463883E3
 700020000E033724E342081111142E49053723975E49051020490E44041838278E467418E3
 00000 12985 13043 21027 21535 24701 24720 27397 27398 27451 28128 28999
 29008 30185 30274 30606 30620 31070 31074 31696 31765 31953 31961 32227
 32230 32598 32648 32765 32940 32942 33178 33214 33291 33410 33411 33572
 33598 33652 33737 33852 33870 33972 34057 34069 34148 34283 34388 34472
 34540 34596 34643 34681 34715 34743 34768 34789 34808 34824 34838 34851
 34863 34873 34882 34890 34898 34905 34911 34917 34922 34926 34931 34935
 34939 34942 34945 34948 34951 34954 34956 34958 34961 34963 34965 34966
 34968 34970 34971 34973 34973 34975 34976 34978 34979 34980 34981 34982
 34982 34983 34984 34985 34986 34986 34987 34988 34988 34989 34989 34990
 34991 34991 34991
     2     2     4     2    10     2     4     6     4     4    14     4
     4    10     2    14    18     2     4    10     2    14    40     2
     4    10     2    80     2     4    10     2   110     2     4    10
     2   144     6   392     2   286   234     2   336   392   450   512
   578   648   722   800   882   968  1058  1152  1250  1352  1458  1568
  1682  1800  1922  2048  2178  2312  2450  2592  2738  2888  3042  3200
  3362  3528  3698  3872  4050  4232  4418  4608  4802  5000  5202  5408
  5618  5832  6050  6272  6498  6728  6962  7200  7442  7688  7938  8192
  8450  8712  8978  9248  9522  9800 10082 10368 10658 10952 11250 11552
 11858 12168 12482
 0.005      1.0
```

Table AIV. Number densities (cm^{-3}) as a function of temperature computed for one atm nitrogen plasmas seeded with potassium at seven different mass ratios.

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 0.

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	0.	3.6701E+18	3.2911E+09	0.	3.4229E-01	1.1926E-07	5.4679E+00	3.6701E+18	0.
2200	0.	3.3364E+18	4.1317E+10	0.	8.5442E+01	2.3816E-04	8.5868E+01	3.3364E+18	0.
2400	0.	3.0584E+18	3.3849E+11	0.	2.6983E+03	4.2530E-02	2.7020E+03	3.0584E+18	0.
2600	0.	2.8231E+18	1.9975E+12	0.	5.0201E+04	3.4239E+00	5.0226E+04	2.8231E+18	0.
2800	0.	2.6215E+18	9.1126E+12	0.	6.1673E+05	1.4744E+02	6.1692E+05	2.6215E+18	0.
3000	0.	2.4467E+18	3.3841E+13	0.	5.4362E+06	3.8475E+03	5.4401E+06	2.4467E+18	0.
3200	0.	2.2937E+18	1.0635E+14	0.	3.6585E+07	6.6805E+04	3.6652E+07	2.2938E+18	0.
3400	0.	2.1586E+18	2.9134E+14	0.	1.9707E+08	8.2895E+05	1.9790E+08	2.1589E+18	0.
3600	0.	2.0382E+18	7.1187E+14	0.	8.8118E+08	7.7688E+06	8.8895E+08	2.0389E+18	0.
3800	0.	1.9300E+18	1.5800E+15	0.	3.3652E+09	5.7428E+07	3.4227E+09	1.9316E+18	0.
4000	0.	1.8318E+18	3.2316E+15	0.	1.1224E+10	3.4656E+08	1.1570E+10	1.8350E+18	0.
4200	0.	1.7415E+18	6.1610E+15	0.	3.3271E+10	1.7550E+09	3.5026E+10	1.7476E+18	0.
4400	0.	1.6572E+18	1.1057E+16	0.	8.8902E+10	7.6247E+09	9.6527E+10	1.6682E+18	0.
4600	0.	1.5769E+18	1.8814E+16	0.	2.1653E+11	2.8942E+10	2.4547E+11	1.5957E+18	0.
4800	0.	1.4987E+18	3.0541E+16	0.	4.8504E+11	9.7438E+10	5.8248E+11	1.5292E+18	0.
5000	0.	1.4205E+18	4.7532E+16	0.	1.0069E+12	2.9468E+11	1.3015E+12	1.4680E+18	0.
5200	0.	1.3404E+18	7.1198E+16	0.	1.9489E+12	8.0938E+11	2.7583E+12	1.4116E+18	0.
5400	0.	1.2563E+18	1.0295E+17	0.	3.5363E+12	2.0386E+12	5.5749E+12	1.3593E+18	0.
5600	0.	1.1667E+18	1.4401E+17	0.	6.0414E+12	4.7490E+12	1.0790E+13	1.3107E+18	0.
5800	0.	1.0703E+18	1.9519E+17	0.	9.7534E+12	1.0309E+13	2.0062E+13	1.2655E+18	0.
6000	0.	9.6673E+17	2.5655E+17	0.	1.4922E+13	2.0985E+13	3.5907E+13	1.2234E+18	0.
6200	0.	8.5659E+17	3.2717E+17	0.	2.1673E+13	4.0305E+13	6.1979E+13	1.1839E+18	0.
6400	0.	7.4182E+17	4.0487E+17	0.	2.9934E+13	7.3358E+13	1.0329E+14	1.1469E+18	0.
6600	0.	6.2568E+17	4.8613E+17	0.	3.9343E+13	1.2706E+14	1.6640E+14	1.1121E+18	0.
6800	0.	5.1250E+17	5.6641E+17	0.	4.9257E+13	2.1017E+14	2.5942E+14	1.0794E+18	0.
7000	0.	4.0703E+17	6.4077E+17	0.	5.8834E+13	3.3312E+14	3.9195E+14	1.0486E+18	0.
7200	0.	3.1354E+17	7.0477E+17	0.	6.7205E+13	5.0763E+14	5.7483E+14	1.0195E+18	0.
7400	0.	2.3486E+17	7.5540E+17	0.	7.3718E+13	7.4634E+14	8.2006E+14	9.9191E+17	0.
7600	0.	1.7188E+17	7.9164E+17	0.	7.8055E+13	1.0627E+15	1.1408E+15	9.6581E+17	0.
7800	0.	1.2364E+17	8.1430E+17	0.	8.0285E+13	1.4712E+15	1.5515E+15	9.4104E+17	0.
8000	0.	8.7986E+16	8.2539E+17	0.	8.0729E+13	1.9876E+15	2.0683E+15	9.1752E+17	0.
8200	0.	6.2300E+16	8.2742E+17	0.	7.9815E+13	2.6293E+15	2.7091E+15	8.9514E+17	0.
8400	0.	4.4103E+16	8.2273E+17	0.	7.7958E+13	3.4157E+15	3.4936E+15	8.7382E+17	0.
8600	0.	3.1320E+16	8.1330E+17	0.	7.5494E+13	4.3676E+15	4.4431E+15	8.5350E+17	0.
8800	0.	2.2363E+16	8.0058E+17	0.	7.2671E+13	5.5075E+15	5.5802E+15	8.3411E+17	0.
9000	0.	1.6076E+16	7.8564E+17	0.	6.9666E+13	6.8591E+15	6.9287E+15	8.1557E+17	0.
9200	0.	1.1644E+16	7.6917E+17	0.	6.6586E+13	8.4467E+15	8.5132E+15	7.9784E+17	0.
9400	0.	8.4981E+15	7.5168E+17	0.	6.3498E+13	1.0295E+16	1.0358E+16	7.8086E+17	0.
9600	0.	6.2496E+15	7.3337E+17	0.	6.0447E+13	1.2429E+16	1.2489E+16	7.6460E+17	0.
9800	0.	4.6292E+15	7.1451E+17	0.	5.7451E+13	1.4871E+16	1.4929E+16	7.4899E+17	0.
10000	0.	3.4522E+15	6.9516E+17	0.	5.4522E+13	1.7647E+16	1.7701E+16	7.3401E+17	0.

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 1.000E-04

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	2.6224E+14	3.6698E+18	3.2910E+09	7.6467E+11	2.1930E-12	7.6414E-19	8.5337E+11	3.6701E+18	7.166E-05
2200	2.3650E+14	3.3362E+18	4.1315E+10	2.5884E+12	2.8341E-09	7.9000E-15	2.5886E+12	3.3364E+18	7.166E-05
2400	2.1237E+14	3.0582E+18	3.3847E+11	6.7950E+12	1.0729E-06	1.6911E-11	6.7950E+12	3.0584E+18	7.166E-05
2600	1.8714E+14	2.8229E+18	1.9975E+12	1.5172E+13	1.6617E-04	1.1334E-08	1.5172E+13	2.8231E+18	7.166E-05
2800	1.5842E+14	2.6212E+18	9.1122E+12	2.9440E+13	1.2923E-02	3.0896E-06	2.9440E+13	2.6215E+18	7.166E-05
3000	1.2523E+14	2.4465E+18	3.3840E+13	5.0096E+13	5.9027E-01	4.1779E-04	5.0096E+13	2.4467E+18	7.166E-05
3200	8.9545E+13	2.2934E+18	1.0634E+14	7.4822E+13	1.7919E+01	3.2723E-02	7.4822E+13	2.2938E+18	7.166E-05
3400	5.6523E+13	2.1583E+18	2.9132E+14	9.8166E+13	3.9723E+02	1.6710E+00	9.8167E+13	2.1589E+18	7.165E-05
3600	3.1737E+13	2.0380E+18	7.1182E+14	1.1434E+14	6.8498E+03	6.0394E+01	1.1434E+14	2.0389E+18	7.164E-05
3800	1.6657E+13	1.9298E+18	1.5799E+15	1.2170E+14	9.4630E+04	1.6150E+03	1.2170E+14	1.9316E+18	7.163E-05
4000	8.7917E+12	1.8315E+18	3.2314E+15	1.2258E+14	1.0592E+06	3.2708E+04	1.2259E+14	1.8350E+18	7.159E-05
4200	4.8677E+12	1.7412E+18	6.1614E+15	1.2014E+14	9.6986E+06	5.1160E+05	1.2014E+14	1.7476E+18	7.153E-05
4400	3.0194E+12	1.6569E+18	1.1056E+16	1.1612E+14	7.3889E+07	6.3376E+06	1.1612E+14	1.6682E+18	7.142E-05
4600	1.9828E+12	1.5766E+18	1.8813E+16	1.1168E+14	4.7582E+08	6.3607E+07	1.1169E+14	1.5957E+18	7.123E-05
4800	1.4886E+12	1.4984E+18	3.0539E+16	1.0699E+14	2.6401E+09	5.3041E+08	1.0700E+14	1.5292E+18	7.094E-05
5000	1.1624E+12	1.4203E+18	4.7528E+16	1.0233E+14	1.2803E+10	3.7472E+09	1.0234E+14	1.4680E+18	7.050E-05
5200	9.5001E+11	1.3402E+18	7.1193E+16	9.7647E+13	5.5000E+10	2.2843E+10	9.7725E+13	1.4116E+18	6.985E-05
5400	8.0041E+11	1.2562E+18	1.0294E+17	9.2913E+13	2.1140E+11	1.2188E+11	9.3246E+13	1.3593E+18	6.894E-05
5600	6.8276E+11	1.1666E+18	1.4400E+17	8.8081E+13	7.3768E+11	5.7991E+11	8.8360E+13	1.3107E+18	6.772E-05
5800	6.1236E+11	1.0702E+18	1.9518E+17	8.3079E+13	2.3452E+12	2.4789E+12	8.3427E+13	1.2655E+18	6.613E-05
6000	5.6501E+11	9.6663E+17	2.5654E+17	7.7904E+13	5.8278E+12	8.1963E+12	9.1928E+13	1.2234E+18	6.414E-05
6200	5.3047E+11	8.5652E+17	3.2716E+17	7.2578E+13	1.2424E+13	2.3106E+13	1.0811E+14	1.1839E+18	6.175E-05
6400	5.2715E+11	7.4176E+17	4.0485E+17	6.7143E+13	2.1745E+13	5.3291E+13	1.4218E+14	1.1469E+18	5.900E-05
6600	5.2633E+11	6.2563E+17	4.8611E+17	6.1736E+13	3.2714E+13	1.0565E+14	2.0010E+14	1.1121E+18	5.598E-05
6800	5.0117E+11	5.1246E+17	5.6639E+17	5.6531E+13	4.4180E+13	1.8851E+14	2.8922E+14	1.0794E+18	5.284E-05
7000	5.2558E+11	4.0700E+17	6.4075E+17	5.1618E+13	5.5085E+13	3.1190E+14	4.1860E+14	1.0486E+18	4.973E-05
7200	5.0651E+11	3.1352E+17	7.0475E+17	4.7238E+13	6.4497E+13	4.8719E+14	5.9892E+14	1.0195E+18	4.683E-05
7400	5.0631E+11	2.3485E+17	7.5538E+17	4.3423E+13	7.1788E+13	7.2683E+14	8.4204E+14	9.9191E+17	4.429E-05
7600	4.9349E+11	1.7187E+17	7.9162E+17	4.0233E+13	7.6686E+13	1.0441E+15	1.1610E+15	9.6581E+17	4.217E-05
7800	5.0771E+11	1.2363E+17	8.1427E+17	3.7588E+13	7.9314E+13	1.4535E+15	1.5704E+15	9.4104E+17	4.048E-05
8000	5.1399E+11	8.7980E+16	8.2536E+17	3.5443E+13	8.0036E+13	1.9706E+15	2.0861E+15	9.1752E+17	3.919E-05
8200	5.1188E+11	6.2296E+16	8.2739E+17	3.3700E+13	7.9315E+13	2.6130E+15	2.7260E+15	8.9514E+17	3.822E-05
8400	5.4930E+11	4.4100E+16	8.2270E+17	3.2219E+13	7.7595E+13	3.3999E+15	3.5097E+15	8.7382E+17	3.750E-05
8600	5.8367E+11	3.1317E+16	8.1327E+17	3.0964E+13	7.5227E+13	4.3523E+15	4.4585E+15	8.5350E+17	3.696E-05
8800	5.5656E+11	2.2361E+16	8.0055E+17	2.9935E+13	7.2472E+13	5.4927E+15	5.5951E+15	8.3411E+17	3.656E-05
9000	5.7738E+11	1.6075E+16	7.8561E+17	2.8976E+13	6.9516E+13	6.8446E+15	6.9431E+15	8.1557E+17	3.624E-05
9200	5.9253E+11	1.1643E+16	7.6914E+17	2.8110E+13	6.6473E+13	8.4326E+15	8.5272E+15	7.9784E+17	3.597E-05
9400	6.0139E+11	8.4975E+15	7.5162E+17	2.7314E+13	6.3411E+13	1.0281E+16	1.0372E+16	7.8086E+17	3.575E-05
9600	6.0362E+11	6.2492E+15	7.3334E+17	2.6572E+13	6.0380E+13	1.2415E+16	1.2502E+16	7.6460E+17	3.554E-05
9800	6.7308E+11	4.6289E+15	7.1448E+17	2.5797E+13	5.7398E+13	1.4858E+16	1.4942E+16	7.4899E+17	3.534E-05
10000	6.6328E+11	3.4520E+15	6.9513E+17	2.5129E+13	5.4480E+13	1.7634E+16	1.7714E+16	7.3401E+17	3.514E-05

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 5.000E-04

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	1.3134E+15	3.6687E+18	3.2905E+09	1.8077E+12	1.0349E-12	3.6064E-19	1.8079E+12	3.6701E+18	3.583E-04
2200	1.1898E+15	3.3352E+18	4.1309E+10	5.8056E+12	1.2632E-09	3.5217E-15	5.8060E+12	3.3364E+18	3.583E-04
2400	1.0806E+15	3.0573E+18	3.3842E+11	1.5328E+13	4.7549E-07	7.4959E-12	1.5328E+13	3.0584E+18	3.583E-04
2600	9.7698E+14	2.8221E+18	1.9972E+12	3.4671E+13	7.2695E-05	4.9591E-09	3.4671E+13	2.8231E+18	3.583E-04
2800	8.7034E+14	2.6205E+18	9.1108E+12	6.9032E+13	5.5094E-03	1.3174E-06	6.9033E+13	2.6215E+18	3.583E-04
3000	7.5371E+14	2.4457E+18	3.3834E+13	1.2302E+14	2.4030E-01	1.7011E-04	1.2302E+14	2.4467E+18	3.583E-04
3200	6.2389E+14	2.2927E+18	1.0633E+14	1.9799E+14	6.7695E+00	1.2364E-02	1.9799E+14	2.2938E+18	3.583E-04
3400	4.8460E+14	2.1575E+18	2.9126E+14	2.8887E+14	1.3494E+02	5.6775E-01	2.8887E+14	2.1589E+18	3.583E-04
3600	3.4764E+14	2.0371E+18	7.1167E+14	3.8274E+14	2.0455E+03	1.8039E+01	3.8274E+14	2.0389E+18	3.582E-04
3800	2.2926E+14	1.9289E+18	1.5795E+15	4.6248E+14	2.4890E+04	4.2488E+02	4.6248E+14	1.9316E+18	3.581E-04
4000	1.4087E+14	1.8306E+18	3.2305E+15	5.1595E+14	2.5153E+05	7.7693E+03	5.1595E+14	1.8350E+18	3.579E-04
4200	8.3620E+13	1.7403E+18	6.1598E+15	5.4135E+14	2.1513E+06	1.1351E+05	5.4135E+14	1.7476E+18	3.576E-04
4400	4.9767E+13	1.6560E+18	1.1053E+16	5.4586E+14	1.5710E+07	1.3479E+06	5.4586E+14	1.6682E+18	3.570E-04
4600	3.1089E+13	1.5758E+18	1.8807E+16	5.3716E+14	9.8878E+07	1.3221E+07	5.3716E+14	1.5957E+18	3.561E-04
4800	2.0659E+13	1.4976E+18	3.0530E+16	5.2167E+14	5.4121E+08	1.0876E+08	5.2167E+14	1.5292E+18	3.546E-04
5000	1.4215E+13	1.4195E+18	4.7515E+16	5.0316E+14	2.6027E+09	7.6198E+08	5.0316E+14	1.4680E+18	3.524E-04
5200	1.0650E+13	1.3394E+18	7.1173E+16	4.8226E+14	1.1139E+10	4.6275E+09	4.8227E+14	1.4116E+18	3.492E-04
5400	8.3855E+12	1.2554E+18	1.0291E+17	4.6011E+14	4.2811E+10	2.4689E+10	4.6017E+14	1.3593E+18	3.447E-04
5600	6.8449E+12	1.1659E+18	1.4396E+17	4.3690E+14	1.4901E+11	1.1718E+11	4.3717E+14	1.3107E+18	3.385E-04
5800	5.7226E+12	1.0696E+18	1.9512E+17	4.1267E+14	4.7273E+11	4.9981E+11	4.1365E+14	1.2655E+18	3.306E-04
6000	4.8189E+12	9.6611E+17	2.5647E+17	3.8748E+14	1.3827E+12	1.9452E+12	3.8723E+14	1.2234E+18	3.207E-04
6200	4.0599E+12	8.5609E+17	3.2708E+17	3.6146E+14	3.7397E+12	6.9567E+12	3.5899E+14	1.1839E+18	3.087E-04
6400	3.5482E+12	7.4141E+17	4.0476E+17	3.3478E+14	8.4877E+12	2.0806E+13	3.6408E+14	1.1469E+18	2.950E-04
6600	3.2004E+12	6.2537E+17	4.8601E+17	3.0811E+14	1.7183E+13	5.5506E+13	3.8080E+14	1.1121E+18	2.799E-04
6800	2.9786E+12	5.1227E+17	5.6629E+17	2.8219E+14	2.9270E+13	1.2492E+14	4.3638E+14	1.0794E+18	2.642E-04
7000	2.8164E+12	4.0686E+17	6.4064E+17	2.5792E+14	4.2565E+13	2.4105E+14	5.4154E+14	1.0486E+18	2.487E-04
7200	2.7849E+12	3.1342E+17	7.0463E+17	2.3596E+14	5.4796E+13	4.1398E+14	7.0473E+14	1.0195E+18	2.342E-04
7400	2.6183E+12	2.3478E+17	7.5526E+17	2.1706E+14	6.4586E+13	6.5401E+14	9.3565E+14	9.9191E+17	2.215E-04
7600	2.6451E+12	1.7182E+17	7.9150E+17	2.0101E+14	7.1460E+13	9.7311E+14	1.2456E+15	9.6581E+17	2.109E-04
7800	2.6629E+12	1.2360E+17	8.1415E+17	1.8784E+14	7.5550E+13	1.3847E+15	1.6481E+15	9.4104E+17	2.024E-04
8000	2.6584E+12	8.7954E+16	8.2524E+17	1.7716E+14	7.7324E+13	1.9041E+15	2.1586E+15	9.1752E+17	1.960E-04
8200	2.6231E+12	6.2277E+16	8.2727E+17	1.6846E+14	7.7350E+13	2.5486E+15	2.7944E+15	8.9514E+17	1.911E-04
8400	2.7970E+12	4.4087E+16	8.2259E+17	1.6107E+14	7.6161E+13	3.3375E+15	3.5748E+15	8.7382E+17	1.875E-04
8600	2.6910E+12	3.1308E+16	8.1315E+17	1.5508E+14	7.4168E+13	4.2916E+15	4.5209E+15	8.5350E+17	1.848E-04
8800	2.8125E+12	2.2354E+16	8.0044E+17	1.4967E+14	7.1683E+13	5.4337E+15	5.6550E+15	8.3411E+17	1.828E-04
9000	2.9110E+12	1.6070E+16	7.8550E+17	1.4488E+14	6.8922E+13	6.7871E+15	7.0009E+15	8.1557E+17	1.812E-04
9200	2.9822E+12	1.1640E+16	7.6903E+17	1.4056E+14	6.6021E+13	8.3765E+15	8.5830E+15	7.9784E+17	1.799E-04
9400	3.0229E+12	8.4951E+15	7.5151E+17	1.3658E+14	6.3064E+13	1.0226E+16	1.0426E+16	7.8086E+17	1.788E-04
9600	3.0310E+12	6.2474E+15	7.3324E+17	1.3287E+14	6.0110E+13	1.2362E+16	1.2555E+16	7.6460E+17	1.777E-04
9800	3.3771E+12	4.6275E+15	7.1438E+17	1.2900E+14	5.7188E+13	1.4806E+16	1.4992E+16	7.4899E+17	1.767E-04
10000	3.3260E+12	3.4510E+15	6.9503E+17	1.2566E+14	5.4314E+13	1.7583E+16	1.7763E+16	7.3401E+17	1.757E-04

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 1.0000E-03

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	2.6281E+15	3.6674E+18	3.2899E+09	2.5571E+12	7.3129E-13	2.5489E-19	2.5575E+12	3.6701E+18	7.168E-04
2200	2.3833E+15	3.3340E+18	4.1302E+10	8.2170E+12	8.9223E-10	2.4879E-15	8.2171E+12	3.3364E+18	7.168E-04
2400	2.1705E+15	3.0562E+18	3.3836E+11	2.1723E+13	3.3538E-07	5.2881E-12	2.1723E+13	3.0584E+18	7.168E-04
2600	1.9743E+15	2.8211E+18	1.9968E+12	4.9289E+13	5.1117E-05	3.4877E-09	4.9289E+13	2.8231E+18	7.168E-04
2800	1.7803E+15	2.6195E+18	9.1092E+12	9.8739E+13	3.8504E-03	9.2088E-07	9.8739E+13	2.6215E+18	7.168E-04
3000	1.5757E+15	2.4447E+18	3.3828E+13	1.7791E+14	1.6609E-01	1.1760E-04	1.7791E+14	2.4467E+18	7.167E-04
3200	1.3523E+15	2.2917E+18	1.0630E+14	2.9165E+14	4.5938E+00	8.3919E-03	2.9165E+14	2.2938E+18	7.167E-04
3400	1.1095E+15	2.1566E+18	2.9120E+14	4.3759E+14	8.9039E+01	3.7471E-01	4.3759E+14	2.1589E+18	7.166E-04
3600	8.5808E+14	2.0361E+18	7.1151E+14	6.0273E+14	1.2983E+03	1.1452E+01	6.0273E+14	2.0389E+18	7.165E-04
3800	6.1918E+14	1.9279E+18	1.5791E+15	7.6428E+14	1.5054E+04	2.5704E+02	7.6428E+14	1.9316E+18	7.162E-04
4000	4.1699E+14	1.8296E+18	3.2296E+15	8.9656E+14	1.4467E+05	4.4698E+03	8.9656E+14	1.8350E+18	7.158E-04
4200	2.6653E+14	1.7393E+18	6.1579E+15	9.8327E+14	1.1837E+06	6.2476E+04	9.8327E+14	1.7476E+18	7.151E-04
4400	1.6605E+14	1.6549E+18	1.1050E+16	1.0250E+15	8.3608E+06	7.1754E+05	1.0250E+15	1.6682E+18	7.140E-04
4600	1.0382E+14	1.5747E+18	1.8801E+16	1.0325E+15	5.1407E+07	6.8762E+06	1.0325E+15	1.5957E+18	7.121E-04
4800	6.7866E+13	1.4966E+18	3.0520E+16	1.0166E+15	2.7753E+08	5.5791E+07	1.0166E+15	1.5292E+18	7.092E-04
5000	4.5508E+13	1.4185E+18	4.7498E+16	9.8904E+14	1.3231E+09	3.8751E+08	9.8904E+14	1.4680E+18	7.047E-04
5200	3.2890E+13	1.3385E+18	7.1148E+16	9.5273E+14	5.6344E+09	2.3416E+09	9.5274E+14	1.4116E+18	6.982E-04
5400	2.5029E+13	1.2546E+18	1.0288E+17	9.1178E+14	2.1591E+10	1.2456E+10	9.1181E+14	1.3593E+18	6.892E-04
5600	1.8914E+13	1.1651E+18	1.4391E+17	8.6842E+14	7.4951E+10	5.8958E+10	8.6855E+14	1.3107E+18	6.770E-04
5800	1.5389E+13	1.0688E+18	1.9505E+17	8.2125E+14	2.3779E+11	2.5150E+11	8.2174E+14	1.2655E+18	6.611E-04
6000	1.2788E+13	9.6542E+17	2.5638E+17	7.7167E+14	6.9189E+11	9.7369E+11	7.7334E+14	1.2234E+18	6.412E-04
6200	1.0776E+13	8.5547E+17	3.2696E+17	7.2013E+14	1.8493E+12	3.4414E+12	7.2542E+14	1.1839E+18	6.174E-04
6400	8.9180E+12	7.4094E+17	4.0463E+17	6.6769E+14	4.6710E+12	1.1454E+13	6.6115E+14	1.1469E+18	5.900E-04
6600	7.5869E+12	6.2497E+17	4.8585E+17	6.1498E+14	9.9518E+12	3.2156E+13	6.5709E+14	1.1121E+18	5.598E-04
6800	7.0280E+12	5.1197E+17	5.6612E+17	5.6330E+14	1.9210E+13	8.2006E+13	6.6452E+14	1.0794E+18	5.284E-04
7000	6.1950E+12	4.0665E+17	6.4048E+17	5.1530E+14	3.1707E+13	1.7961E+14	7.2662E+14	1.0486E+18	4.973E-04
7200	5.9011E+12	3.1327E+17	7.0447E+17	4.7163E+14	4.5039E+13	3.4034E+14	8.5701E+14	1.0195E+18	4.684E-04
7400	5.5389E+12	2.3467E+17	7.5510E+17	4.3386E+14	5.6716E+13	5.7444E+14	1.0650E+15	9.9191E+17	4.430E-04
7600	5.3464E+12	1.7175E+17	7.9134E+17	4.0203E+14	6.5463E+13	8.9163E+14	1.3591E+15	9.6581E+17	4.218E-04
7800	5.2195E+12	1.2355E+17	8.1399E+17	3.7586E+14	7.1105E+13	1.3035E+15	1.7504E+15	9.4104E+17	4.050E-04
8000	5.5457E+12	8.7921E+16	8.2508E+17	3.5415E+14	7.4071E+13	1.8243E+15	2.2525E+15	9.1752E+17	3.920E-04
8200	5.4096E+12	6.2254E+16	8.2711E+17	3.3684E+14	7.4965E+13	2.4704E+15	2.8822E+15	8.9514E+17	3.823E-04
8400	5.7228E+12	4.4071E+16	8.2243E+17	3.2208E+14	7.4406E+13	3.2612E+15	3.6577E+15	8.7382E+17	3.751E-04
8600	5.4758E+12	3.1297E+16	8.1300E+17	3.1013E+14	7.2865E+13	4.2170E+15	4.6000E+15	8.5350E+17	3.698E-04
8800	5.7003E+12	2.2346E+16	8.0029E+17	2.9933E+14	7.0709E+13	5.3608E+15	5.7309E+15	8.3411E+17	3.657E-04
9000	5.8828E+12	1.6064E+16	7.8535E+17	2.8977E+14	6.8187E+13	6.7159E+15	7.0739E+15	8.1557E+17	3.625E-04
9200	6.0136E+12	1.1635E+16	7.6889E+17	2.8113E+14	6.5460E+13	8.3068E+15	8.6534E+15	7.9784E+17	3.599E-04
9400	6.0857E+12	8.4920E+15	7.5138E+17	2.7318E+14	6.2632E+13	1.0158E+16	1.0494E+16	7.8086E+17	3.576E-04
9600	6.0945E+12	6.2451E+15	7.3310E+17	2.6577E+14	5.9775E+13	1.2295E+16	1.2620E+16	7.6460E+17	3.556E-04
9800	6.0378E+12	4.6259E+15	7.1425E+17	2.5878E+14	5.6925E+13	1.4740E+16	1.5056E+16	7.4899E+17	3.536E-04
10000	6.6700E+12	3.4497E+15	6.9491E+17	2.5135E+14	5.4107E+13	1.7519E+16	1.7824E+16	7.3401E+17	3.515E-04

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 5.000E-03

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	1.3163E+16	3.6569E+18	3.2852E+09	5.7227E+12	3.2583E-13	1.1373E-19	5.7235E+12	3.6701E+18	3.588E-03
2200	1.1953E+16	3.3244E+18	4.1242E+10	1.8402E+13	3.9726E-10	1.1093E-15	1.8402E+13	3.3364E+18	3.588E-03
2400	1.0925E+16	3.0474E+18	3.3787E+11	4.8737E+13	1.4906E-07	2.3536E-12	4.8737E+13	3.0584E+18	3.588E-03
2600	1.0018E+16	2.8129E+18	1.9939E+12	1.1104E+14	2.2625E-05	1.5460E-09	1.1104E+14	2.8231E+18	3.588E-03
2800	9.1809E+15	2.6118E+18	9.0958E+12	2.2426E+14	1.6903E-03	4.0485E-07	2.2426E+14	2.6215E+18	3.588E-03
3000	8.3673E+15	2.4375E+18	3.3778E+13	4.1013E+14	7.1836E-02	5.0937E-05	4.1014E+14	2.4467E+18	3.587E-03
3200	7.5385E+15	2.2848E+18	1.0614E+14	6.8909E+14	1.9383E+00	3.5463E-03	6.8909E+14	2.2938E+18	3.587E-03
3400	6.6674E+15	2.1498E+18	2.9074E+14	1.0744E+15	3.6151E+01	1.5238E-01	1.0744E+15	2.1589E+18	3.586E-03
3600	5.7446E+15	2.0293E+18	7.1032E+14	1.5643E+15	4.9857E+02	4.4052E+00	1.5643E+15	2.0389E+18	3.585E-03
3800	4.7839E+15	1.9210E+18	1.5763E+15	2.1363E+15	5.3663E+03	9.1793E+01	2.1363E+15	1.9316E+18	3.583E-03
4000	3.8258E+15	1.8225E+18	3.2234E+15	2.7428E+15	4.7107E+04	1.4583E+03	2.7428E+15	1.8350E+18	3.580E-03
4200	2.9261E+15	1.7319E+18	6.1449E+15	3.3216E+15	3.4892E+05	1.8455E+04	3.3216E+15	1.7476E+18	3.575E-03
4400	2.1411E+15	1.6474E+18	1.1024E+16	3.8111E+15	2.2385E+06	1.9255E+05	3.8111E+15	1.6682E+18	3.568E-03
4600	1.5150E+15	1.5671E+18	1.8756E+16	4.1618E+15	1.2692E+07	1.7017E+06	4.1618E+15	1.5957E+18	3.558E-03
4800	1.0488E+15	1.4890E+18	3.0442E+16	4.3677E+15	6.4268E+07	1.2952E+07	4.3677E+15	1.5292E+18	3.542E-03
5000	7.2101E+14	1.4110E+18	4.7373E+16	4.4454E+15	2.9283E+08	8.5988E+07	4.4454E+15	1.4680E+18	3.519E-03
5200	5.0914E+14	1.3313E+18	7.0957E+16	4.4125E+15	1.2100E+09	5.0423E+08	4.4125E+15	1.4116E+18	3.487E-03
5400	3.5946E+14	1.2477E+18	1.0259E+17	4.3182E+15	4.5341E+09	2.6229E+09	4.3182E+15	1.3593E+18	3.441E-03
5600	2.5825E+14	1.1586E+18	1.4351E+17	4.1723E+15	1.5516E+10	1.2239E+10	4.1723E+15	1.3107E+18	3.380E-03
5800	1.9758E+14	1.0629E+18	1.9451E+17	3.9800E+15	4.8822E+10	5.1782E+10	3.9800E+15	1.2655E+18	3.301E-03
6000	1.4746E+14	9.6001E+17	2.5566E+17	3.7698E+15	1.4112E+11	1.9916E+11	3.7702E+15	1.2234E+18	3.202E-03
6200	1.1811E+14	8.5067E+17	3.2604E+17	3.5322E+15	3.7756E+11	7.0457E+11	3.5332E+15	1.1839E+18	3.083E-03
6400	9.6321E+13	7.3674E+17	4.0348E+17	3.2832E+15	9.3439E+11	2.2977E+12	3.2864E+15	1.1469E+18	2.947E-03
6600	7.4120E+13	6.2148E+17	4.8449E+17	3.0362E+15	2.1354E+12	6.9193E+12	3.0452E+15	1.1121E+18	2.797E-03
6800	6.0955E+13	5.0923E+17	5.6460E+17	2.7894E+15	4.5865E+12	1.9632E+13	2.7684E+15	1.0795E+18	2.641E-03
7000	5.0147E+13	4.0466E+17	6.3891E+17	2.5575E+15	9.2305E+12	5.2416E+13	2.4837E+15	1.0487E+18	2.487E-03
7200	4.2769E+13	3.1173E+17	7.0273E+17	2.3453E+15	1.5499E+13	1.1741E+14	2.4782E+15	1.0195E+18	2.342E-03
7400	3.9428E+13	2.3361E+17	7.5339E+17	2.1588E+15	2.4702E+13	2.5076E+14	2.4343E+15	9.9191E+17	2.216E-03
7600	3.2894E+13	1.7104E+17	7.8970E+17	2.0058E+15	3.5150E+13	4.7975E+14	2.5207E+15	9.6581E+17	2.111E-03
7800	3.1758E+13	1.2308E+17	8.1244E+17	1.8759E+15	4.5099E+13	8.2833E+14	2.7493E+15	9.4104E+17	2.027E-03
8000	2.9689E+13	8.7607E+16	8.2361E+17	1.7712E+15	5.3058E+13	1.3091E+15	3.1334E+15	9.1752E+17	1.963E-03
8200	2.8756E+13	6.2043E+16	8.2571E+17	1.6850E+15	5.8565E+13	1.9333E+15	3.6769E+15	8.9514E+17	1.915E-03
8400	2.8465E+13	4.3927E+16	8.2109E+17	1.6132E+15	6.1811E+13	2.7136E+15	4.3886E+15	8.7382E+17	1.879E-03
8600	2.8501E+13	3.1198E+16	8.1171E+17	1.5522E+15	6.3255E+13	3.6667E+15	5.2621E+15	8.5350E+17	1.852E-03
8800	2.8659E+13	2.2277E+16	7.9905E+17	1.4991E+15	6.3372E+13	4.8120E+15	6.3745E+15	8.3411E+17	1.832E-03
9000	3.1954E+13	1.6015E+16	7.8415E+17	1.4489E+15	6.2578E+13	6.1729E+15	7.6844E+15	8.1557E+17	1.816E-03
9200	3.2109E+13	1.1600E+16	7.6773E+17	1.4062E+15	6.1138E+13	7.7700E+15	9.2373E+15	7.9784E+17	1.803E-03
9400	3.2075E+13	8.4666E+15	7.5026E+17	1.3668E+15	5.9278E+13	9.6286E+15	1.1055E+16	7.8086E+17	1.791E-03
9600	3.1804E+13	6.2266E+15	7.3202E+17	1.3300E+15	5.7153E+13	1.1773E+16	1.3160E+16	7.6460E+17	1.781E-03
9800	3.1266E+13	4.6122E+15	7.1320E+17	1.2953E+15	5.4860E+13	1.4227E+16	1.5577E+16	7.4899E+17	1.771E-03
10000	3.4357E+13	3.4396E+15	6.9389E+17	1.2582E+15	5.2473E+13	1.7015E+16	1.8325E+16	7.3401E+17	1.761E-03

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 1.000E-02

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	2.6366E+16	3.6437E+18	3.2793E+09	8.0999E+12	2.2940E-13	8.0219E-20	8.0999E+12	3.6701E+18	7.186E-03
2200	2.3950E+16	3.3124E+18	4.1168E+10	2.6048E+13	2.7963E-10	7.8226E-16	2.6049E+13	3.3364E+18	7.186E-03
2400	2.1909E+16	3.0363E+18	3.3726E+11	6.9019E+13	1.0487E-07	1.6590E-12	6.9019E+13	3.0584E+18	7.186E-03
2600	2.0129E+16	2.8027E+18	1.9903E+12	1.5739E+14	1.5903E-05	1.0886E-09	1.5740E+14	2.8231E+18	7.186E-03
2800	1.8518E+16	2.6023E+18	9.0792E+12	3.1852E+14	1.1858E-03	2.8453E-07	3.1852E+14	2.6215E+18	7.185E-03
3000	1.6994E+16	2.4285E+18	3.3715E+13	5.8455E+14	5.0216E-02	3.5673E-05	5.8455E+14	2.4467E+18	7.185E-03
3200	1.5488E+16	2.2762E+18	1.0594E+14	9.8796E+14	1.3469E+00	2.4689E-03	9.8796E+14	2.2938E+18	7.183E-03
3400	1.3947E+16	2.1415E+18	2.9018E+14	1.5547E+15	2.4887E+01	1.0510E-01	1.5547E+15	2.1589E+18	7.181E-03
3600	1.2339E+16	2.0213E+18	7.0891E+14	2.2948E+15	3.3852E+02	2.9969E+00	2.2948E+15	2.0389E+18	7.177E-03
3800	1.0660E+16	1.9130E+18	1.5730E+15	3.1927E+15	3.5758E+03	6.1293E+01	3.1927E+15	1.9316E+18	7.172E-03
4000	8.9399E+15	1.8145E+18	3.2162E+15	4.2054E+15	3.0588E+04	9.4898E+02	4.2054E+15	1.8350E+18	7.164E-03
4200	7.2521E+15	1.7238E+18	6.1304E+15	5.2473E+15	2.1983E+05	1.1655E+04	5.2473E+15	1.7476E+18	7.152E-03
4400	5.6693E+15	1.6391E+18	1.0996E+16	6.2346E+15	1.3614E+06	1.1740E+05	6.2346E+15	1.6682E+18	7.136E-03
4600	4.2736E+15	1.5586E+18	1.8704E+16	7.0754E+15	7.4247E+06	9.9826E+05	7.0754E+15	1.5957E+18	7.112E-03
4800	3.1351E+15	1.4803E+18	3.0354E+16	7.6898E+15	3.6291E+07	7.3354E+06	7.6898E+15	1.5292E+18	7.079E-03
5000	2.2548E+15	1.4024E+18	4.7228E+16	8.0672E+15	1.6038E+08	4.7239E+07	8.0672E+15	1.4680E+18	7.031E-03
5200	1.6062E+15	1.3228E+18	7.0730E+16	8.2245E+15	6.4504E+08	2.6966E+08	8.2245E+15	1.4116E+18	6.964E-03
5400	1.1695E+15	1.2395E+18	1.0226E+17	8.1726E+15	2.3800E+09	1.3813E+09	8.1726E+15	1.3593E+18	6.873E-03
5600	8.4348E+14	1.1509E+18	1.4303E+17	8.0044E+15	8.0336E+09	6.3583E+09	8.0045E+15	1.3107E+18	6.750E-03
5800	6.1380E+14	1.0556E+18	1.9384E+17	7.7287E+15	2.4970E+10	2.6575E+10	7.7287E+15	1.2655E+18	6.592E-03
6000	4.7276E+14	9.5340E+17	2.5478E+17	7.3504E+15	7.1888E+10	1.0180E+11	7.3504E+15	1.2234E+18	6.395E-03
6200	3.5240E+14	8.4476E+17	3.2491E+17	6.9381E+15	1.9094E+11	3.5756E+11	6.9380E+15	1.1839E+18	6.158E-03
6400	2.8156E+14	7.3160E+17	4.0207E+17	6.4692E+15	4.7124E+11	1.1629E+12	6.4708E+15	1.1469E+18	5.886E-03
6600	2.1327E+14	6.1712E+17	4.8279E+17	6.0010E+15	1.0752E+12	3.4962E+12	6.0056E+15	1.1121E+18	5.588E-03
6800	1.7520E+14	5.0560E+17	5.6259E+17	5.5207E+15	2.2786E+12	9.7880E+12	5.5327E+15	1.0794E+18	5.277E-03
7000	1.3525E+14	4.0169E+17	6.3655E+17	5.0762E+15	4.4570E+12	2.5403E+13	5.1061E+15	1.0486E+18	4.970E-03
7200	1.1113E+14	3.0975E+17	7.0050E+17	4.6665E+15	8.3921E+12	6.3775E+13	4.5478E+15	1.0197E+18	4.686E-03
7400	1.0167E+14	2.3205E+17	7.5086E+17	4.2961E+15	1.3433E+13	1.3682E+14	4.4463E+15	9.9191E+17	4.434E-03
7600	8.5624E+13	1.6995E+17	7.8718E+17	3.9946E+15	2.0495E+13	2.8062E+14	4.2957E+15	9.6581E+17	4.225E-03
7800	7.5681E+13	1.2235E+17	8.1002E+17	3.7436E+15	2.8662E+13	5.2800E+14	4.3003E+15	9.4104E+17	4.059E-03
8000	7.0542E+13	8.7126E+16	8.2135E+17	3.5363E+15	3.6863E+13	9.1206E+14	4.4852E+15	9.1752E+17	3.931E-03
8200	6.9111E+13	6.1728E+16	8.2361E+17	3.3641E+15	4.4034E+13	1.4573E+15	4.8654E+15	8.9514E+17	3.835E-03
8400	6.4114E+13	4.3718E+16	8.1914E+17	3.2252E+15	4.9507E+13	2.1786E+15	5.4533E+15	8.7382E+17	3.764E-03
8600	6.0989E+13	3.1057E+16	8.0988E+17	3.1065E+15	5.3210E+13	3.0913E+15	6.2510E+15	8.5350E+17	3.711E-03
8800	6.5289E+13	2.2181E+16	7.9733E+17	2.9966E+15	5.5365E+13	4.2131E+15	7.2650E+15	8.3411E+17	3.671E-03
9000	6.3837E+13	1.5948E+16	7.8252E+17	2.9042E+15	5.6221E+13	5.5573E+15	8.5178E+15	8.1557E+17	3.639E-03
9200	6.2589E+13	1.1553E+16	7.6618E+17	2.8202E+15	5.6118E+13	7.1465E+15	1.0023E+16	7.9784E+17	3.613E-03
9400	6.1291E+13	8.4331E+15	7.4877E+17	2.7427E+15	5.5313E+13	9.0023E+15	1.1800E+16	7.8086E+17	3.591E-03
9600	6.7093E+13	6.2024E+15	7.3059E+17	2.6627E+15	5.4027E+13	1.1151E+16	1.3868E+16	7.6460E+17	3.570E-03
9800	6.5332E+13	4.5945E+15	7.1182E+17	2.5938E+15	5.2372E+13	1.3608E+16	1.6254E+16	7.4899E+17	3.550E-03
10000	7.1240E+13	3.4266E+15	6.9257E+17	2.5198E+15	5.0489E+13	1.6403E+16	1.8973E+16	7.3401E+17	3.530E-03

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 5.000E-02

T(K)	N1	N2	N3	N4	N5	N6	NE	NT	A
2000	1.3337E+17	3.5367E+18	3.2308E+09	1.8217E+13	9.9002E-14	3.5140E-20	1.8217E+13	3.6701E+18	3.634E-02
2200	1.2120E+17	3.2151E+18	4.0559E+10	5.8598E+13	1.2065E-10	3.4259E-16	5.8598E+13	3.3364E+18	3.634E-02
2400	1.1100E+17	2.9471E+18	3.3227E+11	1.5535E+14	4.5223E-08	7.2613E-13	1.5535E+14	3.0584E+18	3.634E-02
2600	1.0224E+17	2.7202E+18	1.9608E+12	3.5473E+14	6.8487E-06	4.7587E-10	3.5473E+14	2.8231E+18	3.634E-02
2800	9.4531E+16	2.5255E+18	8.9442E+12	7.1971E+14	5.0930E-04	1.2405E-07	7.1971E+14	2.6215E+18	3.633E-02
3000	8.7549E+16	2.3565E+18	3.3211E+13	1.3270E+15	2.1465E-02	1.5480E-05	1.3270E+15	2.4467E+18	3.632E-02
3200	8.1023E+16	2.2081E+18	1.0435E+14	2.2603E+15	5.7111E-01	1.0629E-03	2.2603E+15	2.2938E+18	3.631E-02
3400	7.4726E+16	2.0766E+18	2.8575E+14	3.6008E+15	1.0420E+01	4.4686E-02	3.6008E+15	2.1589E+18	3.628E-02
3600	6.8483E+16	1.9589E+18	6.9788E+14	5.4117E+15	1.3912E+02	1.2511E+00	5.4117E+15	2.0389E+18	3.624E-02
3800	6.2167E+16	1.8524E+18	1.5479E+15	7.7277E+15	1.4306E+03	2.4919E+01	7.7277E+15	1.9316E+18	3.618E-02
4000	5.5722E+16	1.7551E+18	3.1632E+15	1.0531E+16	1.1815E+04	3.7269E+02	1.0531E+16	1.8350E+18	3.610E-02
4200	4.9158E+16	1.6650E+18	6.0250E+15	1.3751E+16	8.1024E+04	4.3709E+03	1.3751E+16	1.7476E+18	3.600E-02
4400	4.2554E+16	1.5804E+18	1.0798E+16	1.7254E+16	4.7432E+05	4.1657E+04	1.7254E+16	1.6682E+18	3.585E-02
4600	3.6091E+16	1.4996E+18	1.8347E+16	2.0814E+16	2.4285E+06	3.3287E+05	2.0814E+16	1.5957E+18	3.566E-02
4800	2.9948E+16	1.4211E+18	2.9740E+16	2.4210E+16	1.1066E+07	2.2829E+06	2.4210E+16	1.5292E+18	3.542E-02
5000	2.4222E+16	1.3430E+18	4.6217E+16	2.7301E+16	4.5382E+07	1.3660E+07	2.7301E+16	1.4680E+18	3.510E-02
5200	1.9222E+16	1.2637E+18	6.9133E+16	2.9743E+16	1.7040E+08	7.2881E+07	2.9743E+16	1.4116E+18	3.469E-02
5400	1.4971E+16	1.1815E+18	9.9837E+16	3.1474E+16	5.8909E+08	3.5019E+08	3.1474E+16	1.3593E+18	3.417E-02
5600	1.1479E+16	1.0949E+18	1.3951E+17	3.2445E+16	1.8855E+09	1.5300E+09	3.2445E+16	1.3107E+18	3.351E-02
5800	8.6929E+15	1.0026E+18	1.8891E+17	3.2682E+16	5.6083E+09	6.1245E+09	3.2682E+16	1.2655E+18	3.269E-02
6000	6.5210E+15	9.0420E+17	2.4812E+17	3.2260E+16	1.5534E+10	2.2589E+10	3.2260E+16	1.2234E+18	3.170E-02
6200	5.0408E+15	8.0038E+17	3.1626E+17	3.1110E+16	4.0345E+10	7.7619E+10	3.1110E+16	1.1839E+18	3.054E-02
6400	3.7689E+15	6.9250E+17	3.9118E+17	2.9726E+16	9.7098E+10	2.4628E+11	2.9726E+16	1.1469E+18	2.920E-02
6600	2.8125E+15	5.8369E+17	4.6953E+17	2.8056E+16	2.1768E+11	7.2781E+11	2.8057E+16	1.1121E+18	2.776E-02
6800	2.2406E+15	4.7798E+17	5.4701E+17	2.6102E+16	4.5663E+11	2.0174E+12	2.6100E+16	1.0794E+18	2.626E-02
7000	1.6985E+15	3.7955E+17	6.1876E+17	2.4285E+16	8.8523E+11	5.1905E+12	2.4291E+16	1.0486E+18	2.478E-02
7200	1.3007E+15	2.9244E+17	6.8064E+17	2.2564E+16	1.5985E+12	1.2502E+13	2.2541E+16	1.0195E+18	2.341E-02
7400	1.1034E+15	2.1924E+17	7.2985E+17	2.0929E+16	2.7056E+12	2.8351E+13	2.0857E+16	9.9201E+17	2.221E-02
7600	8.7877E+14	1.6068E+17	7.6542E+17	1.9617E+16	4.2883E+12	6.0385E+13	1.9411E+16	9.6608E+17	2.122E-02
7800	7.7903E+14	1.1594E+17	7.8853E+17	1.8466E+16	6.5252E+12	1.2348E+14	1.7900E+16	9.4174E+17	2.045E-02
8000	6.2253E+14	8.3005E+16	8.0169E+17	1.7631E+16	9.7843E+12	2.4801E+14	1.6099E+16	9.1931E+17	1.989E-02
8200	5.8958E+14	5.8493E+16	8.0174E+17	1.6744E+16	1.1832E+13	4.0227E+14	1.7158E+16	8.9514E+17	1.936E-02
8400	5.2258E+14	4.1509E+16	7.9817E+17	1.6108E+16	1.5247E+13	6.8860E+14	1.6812E+16	8.7382E+17	1.903E-02
8600	4.7371E+14	2.9555E+16	7.9006E+17	1.5562E+16	1.8944E+13	1.1282E+15	1.6709E+16	8.5350E+17	1.879E-02
8800	4.3917E+14	2.1160E+16	7.7876E+17	1.5079E+16	2.2741E+13	1.7718E+15	1.6873E+16	8.3411E+17	1.860E-02
9000	4.1638E+14	1.5251E+16	7.6523E+17	1.4641E+16	2.6414E+13	2.6700E+15	1.7337E+16	8.1557E+17	1.846E-02
9200	4.0341E+14	1.1074E+16	7.5010E+17	1.4234E+16	2.9734E+13	3.8677E+15	1.8131E+16	7.9784E+17	1.835E-02
9400	3.9864E+14	8.0994E+15	7.3381E+17	1.3848E+16	3.2515E+13	5.3997E+15	1.9280E+16	7.8086E+17	1.824E-02
9600	4.0068E+14	5.9675E+15	7.1662E+17	1.3477E+16	3.4651E+13	7.2912E+15	2.0803E+16	7.6460E+17	1.815E-02
9800	4.0829E+14	4.4271E+15	6.9873E+17	1.3117E+16	3.6114E+13	9.5593E+15	2.2712E+16	7.4899E+17	1.806E-02
10000	3.7194E+14	3.3056E+15	6.8023E+17	1.2812E+16	3.6890E+13	1.2202E+16	2.5051E+16	7.3401E+17	1.796E-02

Table AV. Absolute emission coefficients as a function of temperature for atomic lines of potassium and nitrogen (watt-cm^{-3}-sr^{-1}), the electron continuum (watt-cm^{-3}-sr^{-1}-sec), and the P-branch increment of the nitrogen molecular ion band head (watt-cm^{-3}-sr^{-1}) computed for one atm nitrogen plasmas seeded with Potassium at seven different mass ratios.

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 0.

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	0.	0.	0.	4.4940E-38	6.6235E-34	5.7777E-45	3.9178E-22
2200	0.	0.	0.	5.9676E-34	4.6555E-30	8.5469E-44	4.6871E-19
2400	0.	0.	0.	1.6200E-30	7.4379E-27	8.0733E-41	5.3117E-17
2600	0.	0.	0.	1.2973E-27	3.8033E-24	2.6776E-38	2.8863E-15
2800	0.	0.	0.	3.9819E-25	7.9471E-22	3.8914E-36	8.7686E-14
3000	0.	0.	0.	5.6760E-23	8.1178E-20	2.9231E-34	1.6736E-12
3200	0.	0.	0.	4.3393E-21	4.6368E-18	1.2847E-32	2.1898E-11
3400	0.	0.	0.	1.9863E-19	1.6409E-16	3.6336E-31	2.0996E-10
3600	0.	0.	0.	5.9302E-18	3.8974E-15	7.1253E-30	1.5531E-09
3800	0.	0.	0.	1.2355E-16	6.6171E-14	1.0281E-28	9.2274E-09
4000	0.	0.	0.	1.8955E-15	8.4449E-13	1.1451E-27	4.5458E-08
4200	0.	0.	0.	2.2372E-14	8.4372E-12	1.0241E-26	1.9044E-07
4400	0.	0.	0.	2.1046E-13	6.8217E-11	7.5992E-26	6.9241E-07
4600	0.	0.	0.	1.6249E-12	4.5866E-10	4.8063E-25	2.2209E-06
4800	0.	0.	0.	1.0547E-11	2.6226E-09	2.6494E-24	6.3685E-06
5000	0.	0.	0.	5.8721E-11	1.2994E-08	1.2961E-23	1.6509E-05
5200	0.	0.	0.	2.8512E-10	5.6652E-08	5.7079E-23	3.9046E-05
5400	0.	0.	0.	1.2243E-09	2.2018E-07	2.2881E-22	8.4934E-05
5600	0.	0.	0.	4.7026E-09	7.7095E-07	8.4175E-22	1.7103E-04
5800	0.	0.	0.	1.6314E-08	2.4538E-06	2.8892E-21	3.2060E-04
6000	0.	0.	0.	5.1524E-08	7.1505E-06	9.0048E-21	5.6194E-04
6200	0.	0.	0.	1.4911E-07	1.9193E-05	2.6893E-20	9.2396E-04
6400	0.	0.	0.	3.9756E-07	4.7688E-05	7.2150E-20	1.4291E-03
6600	0.	0.	0.	9.8111E-07	1.1014E-04	1.8438E-19	2.0834E-03
6800	0.	0.	0.	2.2507E-06	2.3739E-04	4.4154E-19	2.8680E-03
7000	0.	0.	0.	4.8196E-06	4.7931E-04	9.9339E-19	3.7368E-03
7200	0.	0.	0.	9.6781E-06	9.1050E-04	2.1067E-18	4.6229E-03
7400	0.	0.	0.	1.8322E-05	1.6354E-03	4.2293E-18	5.4557E-03
7600	0.	0.	0.	3.2891E-05	2.7934E-03	8.0758E-18	6.1787E-03
7800	0.	0.	0.	5.6342E-05	4.5644E-03	1.4745E-17	6.7605E-03
8000	0.	0.	0.	9.2656E-05	7.1769E-03	2.5875E-17	7.1953E-03
8200	0.	0.	0.	1.4709E-04	1.0917E-02	4.3848E-17	7.4851E-03
8400	0.	0.	0.	2.2646E-04	1.6139E-02	7.2046E-17	7.6805E-03
8600	0.	0.	0.	3.3946E-04	2.3273E-02	1.1516E-16	7.7729E-03
8800	0.	0.	0.	4.9691E-04	3.2830E-02	1.7958E-16	7.7916E-03
9000	0.	0.	0.	7.1208E-04	4.5412E-02	2.7377E-16	7.7520E-03
9200	0.	0.	0.	1.0009E-03	6.1710E-02	4.0878E-16	7.6663E-03
9400	0.	0.	0.	1.3821E-03	8.2496E-02	5.9871E-16	7.5427E-03
9600	0.	0.	0.	1.8772E-03	1.0863E-01	8.6123E-16	7.3885E-03
9800	0.	0.	0.	2.5106E-03	1.4102E-01	1.2180E-15	7.2078E-03
10000	0.	0.	0.	3.3094E-03	1.8066E-01	1.6951E-15	7.0048E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 1.000E-04

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	4.6607E-10	2.8024E-09	9.4166E-08	4.4938E-38	6.6233E-34	9.8314E-24	2.5101E-33
2200	3.6796E-09	1.8192E-08	5.1116E-07	5.9674E-34	4.6553E-30	7.7290E-23	1.5448E-29
2400	2.0139E-08	8.4580E-08	2.0475E-06	1.6200E-30	7.4376E-27	5.0988E-22	2.1120E-26
2600	8.1827E-08	2.9936E-07	6.3882E-06	1.2973E-27	3.8031E-24	2.4423E-21	9.5542E-24
2800	2.5643E-07	8.3345E-07	1.5963E-05	3.9817E-25	7.9468E-22	8.8613E-21	1.8373E-21
3000	6.2877E-07	1.8445E-06	3.2169E-05	5.6757E-23	8.1174E-20	2.4789E-20	1.8172E-19
3200	1.2852E-06	3.2320E-06	5.1931E-05	4.3391E-21	4.6362E-18	5.3541E-20	1.0726E-17
3400	1.8046E-06	4.4711E-06	6.6828E-05	1.9862E-19	1.6408E-16	8.9410E-20	4.2322E-16
3600	2.1524E-06	4.9705E-06	6.9666E-05	5.9298E-18	3.8972E-15	1.1789E-19	1.2073E-14
3800	2.1633E-06	4.6910E-06	6.2073E-05	1.2354E-16	6.6167E-14	1.2998E-19	2.5947E-13
4000	1.9631E-06	4.0223E-06	5.0539E-05	1.8954E-15	8.4444E-13	1.2854E-19	4.2900E-12
4200	1.6984E-06	3.3061E-06	3.9639E-05	2.2370E-14	8.4367E-12	1.2050E-19	5.5514E-11
4400	1.4381E-06	2.6719E-06	3.0700E-05	2.1045E-13	6.8212E-11	1.0998E-19	5.7549E-10
4600	1.2125E-06	2.1588E-06	2.3859E-05	1.6248E-12	4.5863E-10	9.9497E-20	4.8806E-09
4800	1.0193E-06	1.7455E-06	1.8616E-05	1.0547E-11	2.6224E-09	8.9397E-20	3.4664E-08
5000	8.5804E-07	1.4175E-06	1.4630E-05	5.8717E-11	1.2993E-08	8.0139E-20	2.0991E-07
5200	7.2236E-07	1.1545E-06	1.1560E-05	2.8510E-10	5.6648E-08	7.1648E-20	1.1019E-06
5400	6.0822E-07	9.4270E-07	9.1785E-06	1.2242E-09	2.2016E-07	6.4012E-20	5.0773E-06
5600	5.0842E-07	7.6590E-07	7.2656E-06	4.7023E-09	7.7090E-07	5.5788E-20	2.0884E-05
5800	4.2264E-07	6.2002E-07	5.7409E-06	1.6313E-08	2.4536E-06	4.6924E-20	7.7089E-05
6000	4.0880E-07	5.8506E-07	5.2961E-06	5.1521E-08	7.1502E-06	5.9022E-20	2.1947E-04
6200	4.2040E-07	5.8788E-07	5.2102E-06	1.4910E-07	1.9192E-05	8.0301E-20	5.2966E-04
6400	4.8126E-07	6.5854E-07	5.7218E-06	3.9754E-07	4.7686E-05	1.3670E-19	1.0382E-03
6600	5.8730E-07	7.8743E-07	6.7154E-06	9.8108E-07	1.1014E-04	2.6664E-19	1.7324E-03
6800	7.3458E-07	9.6617E-07	8.0965E-06	2.2506E-06	2.3738E-04	5.4878E-19	2.5724E-03
7000	9.1926E-07	1.1874E-06	9.7872E-06	4.8194E-06	4.7929E-04	1.1331E-18	3.4986E-03
7200	1.1418E-06	1.4499E-06	1.1766E-05	9.6778E-06	9.1046E-04	2.2870E-18	4.4366E-03
7400	1.4023E-06	1.7521E-06	1.4010E-05	1.8321E-05	1.6354E-03	4.4591E-18	5.3129E-03
7600	1.7052E-06	2.0982E-06	1.6544E-05	3.2890E-05	2.7933E-03	8.3654E-18	6.0704E-03
7800	2.0541E-06	2.4910E-06	1.9382E-05	5.6340E-05	4.5642E-03	1.5106E-17	6.6788E-03
8000	2.4562E-06	2.9378E-06	2.2572E-05	9.2652E-05	7.1766E-03	2.6321E-17	7.1336E-03
8200	2.9173E-06	3.4438E-06	2.6144E-05	1.4708E-04	1.0917E-02	4.4395E-17	7.4482E-03
8400	3.4370E-06	4.0069E-06	3.0074E-05	2.2646E-04	1.6139E-02	7.2711E-17	7.6448E-03
8600	4.0212E-06	4.6324E-06	3.4391E-05	3.3945E-04	2.3272E-02	1.1596E-16	7.7454E-03
8800	4.6804E-06	5.3307E-06	3.9167E-05	4.9690E-04	3.2829E-02	1.8054E-16	7.7703E-03
9000	5.3996E-06	6.0834E-06	4.4255E-05	7.1206E-04	4.5411E-02	2.7491E-16	7.7354E-03
9200	6.1851E-06	6.8963E-06	4.9694E-05	1.0009E-03	6.1708E-02	4.1012E-16	7.6532E-03
9400	7.0350E-06	7.7662E-06	5.5456E-05	1.3820E-03	8.2493E-02	6.0027E-16	7.5324E-03
9600	7.9465E-06	8.6891E-06	6.1507E-05	1.8771E-03	1.0862E-01	8.6304E-16	7.3802E-03
9800	8.8896E-06	9.6317E-06	6.7611E-05	2.5106E-03	1.4102E-01	1.2200E-15	7.2011E-03
10000	9.9058E-06	1.0639E-05	7.4084E-05	3.3093E-03	1.8065E-01	1.6975E-15	6.9995E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 5.000E-04

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	2.3392E-09	1.4035E-08	4.7161E-07	4.4932E-38	6.6223E-34	3.9545E-23	1.1845E-33
2200	1.8511E-08	9.1518E-08	2.5715E-06	5.9665E-34	4.6547E-30	3.8883E-22	6.8852E-30
2400	1.0248E-07	4.3038E-07	1.0419E-05	1.6197E-30	7.4366E-27	2.5945E-21	9.3602E-27
2600	4.2731E-07	1.5633E-06	3.3360E-05	1.2971E-27	3.8025E-24	1.2754E-20	4.1797E-24
2800	1.4099E-06	4.5825E-06	8.7770E-05	3.9811E-25	7.9456E-22	4.8722E-20	7.8332E-22
3000	3.7914E-06	1.1122E-05	1.9397E-04	5.6748E-23	8.1161E-20	1.4947E-19	7.3979E-20
3200	8.4387E-06	2.2631E-05	3.6362E-04	4.3384E-21	4.6354E-18	3.7490E-19	4.0519E-18
3400	1.5626E-05	3.8716E-05	5.7868E-04	1.9858E-19	1.6405E-16	7.7422E-19	1.4377E-16
3600	2.4116E-05	5.5692E-05	7.8057E-04	5.9286E-18	3.8963E-15	1.3208E-18	3.6052E-15
3800	3.1241E-05	6.7743E-05	8.9640E-04	1.2351E-16	6.6151E-14	1.8771E-18	6.8248E-14
4000	3.4776E-05	7.1255E-05	8.9529E-04	1.8949E-15	8.4422E-13	2.2771E-18	1.0188E-12
4200	3.4483E-05	6.7124E-05	8.0479E-04	2.2364E-14	8.4344E-12	2.4464E-18	1.2314E-11
4400	3.1777E-05	5.9039E-05	6.7835E-04	2.1039E-13	6.8194E-11	2.4301E-18	1.2236E-10
4600	2.8047E-05	4.9938E-05	5.5190E-04	1.6244E-12	4.5850E-10	2.3016E-18	1.0142E-09
4800	2.4231E-05	4.1494E-05	4.4252E-04	1.0544E-11	2.6217E-09	2.1250E-18	7.1059E-09
5000	2.0742E-05	3.4267E-05	3.5367E-04	5.8701E-11	1.2989E-08	1.9370E-18	4.2673E-08
5200	1.7606E-05	2.8138E-05	2.8175E-04	2.8502E-10	5.6632E-08	1.7449E-18	2.2316E-07
5400	1.4864E-05	2.3038E-05	2.2431E-04	1.2238E-09	2.2010E-07	1.5590E-18	1.0282E-06
5600	1.2477E-05	1.8796E-05	1.7831E-04	4.7009E-09	7.7068E-07	1.3817E-18	4.2185E-06
5800	1.0409E-05	1.5270E-05	1.4139E-04	1.6309E-08	2.4529E-06	1.2155E-18	1.5539E-05
6000	8.5650E-06	1.2258E-05	1.1096E-04	5.1507E-08	7.1482E-06	1.0377E-18	5.2073E-05
6200	6.9523E-06	9.7221E-06	8.6164E-05	1.4906E-07	1.9188E-05	8.5410E-19	1.5943E-04
6400	6.1447E-06	8.4082E-06	7.3056E-05	3.9745E-07	4.7675E-05	8.9639E-19	4.0523E-04
6600	5.5779E-06	7.4786E-06	6.3779E-05	9.8087E-07	1.1011E-04	9.6563E-19	9.0994E-04
6800	5.5326E-06	7.2769E-06	6.0980E-05	2.2502E-06	2.3734E-04	1.2493E-18	1.7043E-03
7000	5.9422E-06	7.6755E-06	6.3266E-05	4.8186E-06	4.7921E-04	1.8963E-18	2.7035E-03
7200	6.7112E-06	8.5218E-06	6.9154E-05	9.6762E-06	9.1032E-04	3.1665E-18	3.7693E-03
7400	7.7889E-06	9.7317E-06	7.7814E-05	1.8318E-05	1.6351E-03	5.5057E-18	4.7799E-03
7600	9.1399E-06	1.1246E-05	8.8675E-05	3.2885E-05	2.7929E-03	9.6280E-18	5.6567E-03
7800	1.0773E-05	1.3065E-05	1.0165E-04	5.6332E-05	4.5635E-03	1.6638E-17	6.3619E-03
8000	1.2703E-05	1.5194E-05	1.1674E-04	9.2639E-05	7.1756E-03	2.8183E-17	6.8919E-03
8200	1.4949E-05	1.7647E-05	1.3397E-04	1.4706E-04	1.0915E-02	4.6652E-17	7.2637E-03
8400	1.7501E-05	2.0403E-05	1.5313E-04	2.2642E-04	1.6136E-02	7.5431E-17	7.5035E-03
8600	2.0421E-05	2.3524E-05	1.7465E-04	3.3940E-04	2.3268E-02	1.1923E-16	7.6364E-03
8800	2.3652E-05	2.6939E-05	1.9793E-04	4.9682E-04	3.2824E-02	1.8443E-16	7.6857E-03
9000	2.7223E-05	3.0671E-05	2.2312E-04	7.1195E-04	4.5404E-02	2.7950E-16	7.6693E-03
9200	3.1130E-05	3.4709E-05	2.5011E-04	1.0007E-03	6.1699E-02	4.1551E-16	7.6012E-03
9400	3.5361E-05	3.9036E-05	2.7874E-04	1.3818E-03	8.2481E-02	6.0655E-16	7.4911E-03
9600	3.9903E-05	4.3632E-05	3.0885E-04	1.8769E-03	1.0861E-01	8.7029E-16	7.3473E-03
9800	4.4603E-05	4.8327E-05	3.3924E-04	2.5102E-03	1.4100E-01	1.2283E-15	7.1747E-03
10000	4.9672E-05	5.3348E-05	3.7149E-04	3.3088E-03	1.8063E-01	1.7069E-15	6.9781E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 1.000E-03

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	4.6709E-09	2.8086E-08	9.4373E-07	4.4923E-38	6.6211E-34	7.9134E-23	8.3702E-34
2200	3.7080E-08	1.8332E-07	5.1511E-06	5.9654E-34	4.6538E-30	7.7879E-22	4.8632E-30
2400	2.0583E-07	8.6446E-07	2.0927E-05	1.6194E-30	7.4352E-27	5.2113E-21	6.6021E-27
2600	8.6360E-07	3.1594E-06	6.7420E-05	1.2968E-27	3.8019E-24	2.5776E-20	2.9390E-24
2800	2.8844E-06	9.3751E-06	1.7956E-04	3.9804E-25	7.9441E-22	9.9677E-20	5.4745E-22
3000	7.9303E-06	2.3264E-05	4.0572E-04	5.6737E-23	8.1146E-20	3.1264E-19	5.1133E-20
3200	1.8310E-05	4.9105E-05	7.8900E-04	4.3375E-21	4.6345E-18	8.1347E-19	2.7496E-18
3400	3.5858E-05	8.8844E-05	1.3279E-03	1.9854E-19	1.6401E-16	1.7766E-18	9.4866E-17
3600	5.9806E-05	1.3811E-04	1.9358E-03	5.9272E-18	3.8954E-15	3.2756E-18	2.2883E-15
3800	8.5319E-05	1.8501E-04	2.4481E-03	1.2348E-16	6.6134E-14	5.1264E-18	4.1277E-14
4000	1.0501E-04	2.1516E-04	2.7034E-03	1.8944E-15	8.4399E-13	6.8758E-18	5.8594E-13
4200	1.1376E-04	2.2144E-04	2.6550E-03	2.2357E-14	8.4318E-12	8.0708E-18	6.7754E-12
4400	1.1205E-04	2.0819E-04	2.3920E-03	2.1032E-13	6.8172E-11	8.5692E-18	6.5118E-11
4600	1.0362E-04	1.8450E-04	2.0391E-03	1.6238E-12	4.5835E-10	8.5033E-18	5.2729E-10
4800	9.2019E-05	1.5757E-04	1.6805E-03	1.0540E-11	2.6208E-09	8.0699E-18	3.6439E-09
5000	8.0145E-05	1.3240E-04	1.3665E-03	5.8680E-11	1.2985E-08	7.4841E-18	2.1694E-08
5200	6.8713E-05	1.0982E-04	1.0996E-03	2.8492E-10	5.6612E-08	6.8100E-18	1.1288E-07
5400	5.8364E-05	9.0462E-05	8.8077E-04	1.2234E-09	2.2002E-07	6.1208E-18	5.1857E-07
5600	4.9274E-05	7.4227E-05	7.0414E-04	4.6993E-09	7.7041E-07	5.4538E-18	2.1218E-06
5800	4.1152E-05	6.0370E-05	5.5898E-04	1.6303E-08	2.4521E-06	4.7968E-18	7.8164E-06
6000	3.4065E-05	4.8753E-05	4.4132E-04	5.1489E-08	7.1457E-06	4.1769E-18	2.6056E-05
6200	2.7990E-05	3.9141E-05	3.4689E-04	1.4901E-07	1.9181E-05	3.6156E-18	7.8838E-05
6400	2.2255E-05	3.0453E-05	2.6459E-04	3.9732E-07	4.7660E-05	2.8580E-18	2.2301E-04
6600	1.9212E-05	2.5758E-05	2.1967E-04	9.8056E-07	1.1008E-04	2.8753E-18	5.2699E-04
6800	1.6818E-05	2.2120E-05	1.8537E-04	2.2495E-06	2.3727E-04	2.8971E-18	1.1185E-03
7000	1.5929E-05	2.0576E-05	1.6960E-04	4.8173E-06	4.7908E-04	3.4140E-18	2.0138E-03
7200	1.6313E-05	2.0714E-05	1.6809E-04	9.6740E-06	9.1011E-04	4.6828E-18	3.0981E-03
7400	1.7722E-05	2.2142E-05	1.7705E-04	1.8314E-05	1.6348E-03	7.1335E-18	4.1975E-03
7600	1.9947E-05	2.4543E-05	1.9352E-04	3.2878E-05	2.7923E-03	1.1463E-17	5.1820E-03
7800	2.2895E-05	2.7765E-05	2.1603E-04	5.6321E-05	4.5626E-03	1.8769E-17	5.9875E-03
8000	2.6501E-05	3.1697E-05	2.4354E-04	9.2621E-05	7.1742E-03	3.0690E-17	6.6019E-03
8200	3.0830E-05	3.6394E-05	2.7629E-04	1.4703E-04	1.0913E-02	4.9631E-17	7.0397E-03
8400	3.5808E-05	4.1745E-05	3.1332E-04	2.2638E-04	1.6133E-02	7.8973E-17	7.3306E-03
8600	4.1553E-05	4.7869E-05	3.5538E-04	3.3934E-04	2.3264E-02	1.2344E-16	7.5022E-03
8800	4.7937E-05	5.4598E-05	4.0115E-04	4.9673E-04	3.2818E-02	1.8941E-16	7.5813E-03
9000	5.5015E-05	6.1982E-05	4.5090E-04	7.1182E-04	4.5396E-02	2.8536E-16	7.5874E-03
9200	6.2773E-05	6.9991E-05	5.0435E-04	1.0005E-03	6.1688E-02	4.2236E-16	7.5367E-03
9400	7.1190E-05	7.8589E-05	5.6117E-04	1.3816E-03	8.2466E-02	6.1449E-16	7.4399E-03
9600	8.0233E-05	8.7731E-05	6.2101E-04	1.8765E-03	1.0859E-01	8.7944E-16	7.3063E-03
9800	8.9857E-05	9.7358E-05	6.8342E-04	2.5097E-03	1.4097E-01	1.2388E-15	7.1417E-03
10000	9.9703E-05	1.0708E-04	7.4566E-04	3.3082E-03	1.8059E-01	1.7188E-15	6.9515E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 5.000E-03

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	2.3394E-08	1.4066E-07	4.7265E-06	4.4859E-38	6.6116E-34	3.9633E-22	3.7294E-34
2200	1.8596E-07	9.1940E-07	2.5834E-05	5.9568E-34	4.6471E-30	3.9058E-21	2.1653E-30
2400	1.0360E-06	4.3513E-06	1.0533E-04	1.6171E-30	7.4245E-27	2.6231E-20	2.9342E-27
2600	4.3827E-06	1.6034E-05	3.4215E-04	1.2950E-27	3.7964E-24	1.3081E-19	1.3009E-24
2800	1.4880E-05	4.8363E-05	9.2631E-04	3.9746E-25	7.9325E-22	5.1421E-19	2.4033E-22
3000	4.2144E-05	1.2363E-04	2.1561E-03	5.6653E-23	8.1025E-20	1.6615E-18	2.2115E-20
3200	1.0222E-04	2.7413E-04	4.4047E-03	4.3309E-21	4.6274E-18	4.5413E-18	1.1602E-18
3400	2.1615E-04	5.3556E-04	8.0047E-03	1.9823E-19	1.6375E-16	1.0710E-17	3.8516E-17
3600	4.0285E-04	9.3032E-04	1.3039E-02	5.9173E-18	3.8889E-15	2.2064E-17	8.7872E-16
3800	6.6660E-04	1.4455E-03	1.9127E-02	1.2326E-16	6.6016E-14	4.0052E-17	1.4714E-14
4000	9.8274E-04	2.0136E-03	2.5300E-02	1.8907E-15	8.4235E-13	6.4350E-17	1.9079E-13
4200	1.2982E-03	2.5271E-03	3.0299E-02	2.2310E-14	8.4141E-12	9.2104E-17	1.9972E-12
4400	1.5490E-03	2.8779E-03	3.3067E-02	2.0984E-13	6.8017E-11	1.1846E-16	1.7434E-11
4600	1.6836E-03	2.9978E-03	3.3131E-02	1.6199E-12	4.5724E-10	1.3816E-16	1.3018E-10
4800	1.6986E-03	2.9087E-03	3.1021E-02	1.0513E-11	2.6141E-09	1.4897E-16	8.4382E-10
5000	1.6191E-03	2.6748E-03	2.7606E-02	5.8526E-11	1.2951E-08	1.5119E-16	4.8013E-09
5200	1.4739E-03	2.3556E-03	2.3587E-02	2.8415E-10	5.6460E-08	1.4607E-16	2.4243E-08
5400	1.3090E-03	2.0289E-03	1.9755E-02	1.2201E-09	2.1942E-07	1.3728E-16	1.0890E-07
5600	1.1372E-03	1.7131E-03	1.6251E-02	4.6862E-09	7.6828E-07	1.2585E-16	4.3926E-07
5800	9.6594E-04	1.4170E-03	1.3121E-02	1.6258E-08	2.4452E-06	1.1252E-16	1.6048E-06
6000	8.1132E-04	1.1611E-03	1.0511E-02	5.1344E-08	7.1256E-06	9.9276E-17	5.3146E-06
6200	6.6867E-04	9.3506E-04	8.2872E-03	1.4859E-07	1.9127E-05	8.5773E-17	1.6096E-05
6400	5.4394E-04	7.4432E-04	6.4671E-03	3.9619E-07	4.7525E-05	7.3037E-17	4.4611E-05
6600	4.3956E-04	5.8935E-04	5.0261E-03	9.7782E-07	1.0977E-04	6.1754E-17	1.1308E-04
6800	3.4695E-04	4.5633E-04	3.8240E-03	2.2435E-06	2.3663E-04	4.9472E-17	2.6705E-04
7000	2.7024E-04	3.4907E-04	2.8772E-03	4.8055E-06	4.7791E-04	3.7827E-17	5.8626E-04
7200	2.3457E-04	2.9786E-04	2.4171E-03	9.6501E-06	9.0786E-04	3.9156E-17	1.0661E-03
7400	2.0155E-04	2.5182E-04	2.0135E-03	1.8273E-05	1.6311E-03	3.7267E-17	1.8281E-03
7600	1.8457E-04	2.2711E-04	1.7907E-03	3.2810E-05	2.7865E-03	3.9432E-17	2.7825E-03
7800	1.7947E-04	2.1764E-04	1.6934E-03	5.6213E-05	4.5539E-03	4.6301E-17	3.7977E-03
8000	1.8437E-04	2.2052E-04	1.6944E-03	9.2456E-05	7.1614E-03	5.9387E-17	4.7290E-03
8200	1.9675E-04	2.3226E-04	1.7632E-03	1.4678E-04	1.0895E-02	8.0770E-17	5.4996E-03
8400	2.1519E-04	2.5087E-04	1.8829E-03	2.2601E-04	1.6107E-02	1.1369E-16	6.0897E-03
8600	2.3880E-04	2.7510E-04	2.0424E-03	3.3880E-04	2.3227E-02	1.6276E-16	6.5128E-03
8800	2.6705E-04	3.0416E-04	2.2347E-03	4.9596E-04	3.2767E-02	2.3434E-16	6.7946E-03
9000	2.9883E-04	3.3667E-04	2.4492E-03	7.1074E-04	4.5327E-02	3.3674E-16	6.9633E-03
9200	3.3517E-04	3.7371E-04	2.6929E-03	9.9904E-04	6.1595E-02	4.8128E-16	7.0390E-03
9400	3.7521E-04	4.1421E-04	2.9577E-03	1.3795E-03	8.2343E-02	6.8191E-16	7.0415E-03
9600	4.1869E-04	4.5782E-04	3.2407E-03	1.8738E-03	1.0843E-01	9.5629E-16	6.9858E-03
9800	4.6531E-04	5.0416E-04	3.5390E-03	2.5060E-03	1.4077E-01	1.3260E-15	6.8826E-03
10000	5.1311E-04	5.5108E-04	3.8375E-03	3.3034E-03	1.8033E-01	1.8168E-15	6.7416E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 1.000E-02

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	4.6860E-08	2.8177E-07	9.4677E-06	4.4778E-38	6.5997E-34	7.9368E-22	2.6257E-34
2200	3.7263E-07	1.8423E-06	5.1765E-05	5.9461E-34	4.6387E-30	7.8262E-21	1.5242E-30
2400	2.0778E-06	8.7263E-06	2.1125E-04	1.6142E-30	7.4111E-27	5.2606E-20	2.0645E-27
2600	8.8064E-06	3.2217E-05	6.8751E-04	1.2926E-27	3.7895E-24	2.6284E-19	9.1437E-25
2800	3.0016E-05	9.7559E-05	1.8686E-03	3.9673E-25	7.9180E-22	1.0373E-18	1.6859E-22
3000	8.5611E-05	2.5114E-04	4.3799E-03	5.6549E-23	8.0876E-20	3.3751E-18	1.5459E-20
3200	2.1012E-04	5.6349E-04	9.0540E-03	4.3228E-21	4.6188E-18	9.3348E-18	8.0619E-19
3400	4.5261E-04	1.1214E-03	1.6761E-02	1.9785E-19	1.6344E-16	2.2425E-17	2.6515E-17
3600	8.6693E-04	2.0020E-03	2.8060E-02	5.9055E-18	3.8812E-15	4.7482E-17	5.9663E-16
3800	1.4889E-03	3.2285E-03	4.2721E-02	1.2300E-16	6.5879E-14	8.9458E-17	9.8047E-15
4000	2.3103E-03	4.7338E-03	5.9479E-02	1.8866E-15	8.4049E-13	1.5128E-16	1.2388E-13
4200	3.2398E-03	6.3065E-03	7.5614E-02	2.2258E-14	8.3942E-12	2.2985E-16	1.2583E-12
4400	4.1455E-03	7.7020E-03	8.8495E-02	2.0931E-13	6.7844E-11	3.1702E-16	1.0603E-11
4600	4.8661E-03	8.6642E-03	9.5755E-02	1.6155E-12	4.5599E-10	3.9932E-16	7.6156E-11
4800	5.2652E-03	9.0162E-03	9.6156E-02	1.0483E-11	2.6065E-09	4.6175E-16	4.7650E-10
5000	5.3320E-03	8.8088E-03	9.0914E-02	5.8346E-11	1.2911E-08	4.9792E-16	2.6296E-09
5200	5.1205E-03	8.1837E-03	8.1944E-02	2.8324E-10	5.6279E-08	5.0747E-16	1.2923E-08
5400	4.6889E-03	7.2676E-03	7.0760E-02	1.2160E-09	2.1870E-07	4.9172E-16	5.7162E-08
5600	4.1855E-03	6.3052E-03	5.9813E-02	4.6705E-09	7.6570E-07	4.6320E-16	2.2743E-07
5800	3.6425E-03	5.3435E-03	4.9477E-02	1.6202E-08	2.4369E-06	4.2432E-16	8.2080E-07
6000	3.0841E-03	4.4138E-03	3.9955E-02	5.1167E-08	7.1011E-06	3.7734E-16	2.7072E-06
6200	2.5791E-03	3.6066E-03	3.1964E-02	1.4807E-07	1.9060E-05	3.3069E-16	8.1400E-06
6400	2.1103E-03	2.8877E-03	2.5090E-02	3.9481E-07	4.7359E-05	2.8316E-16	2.2499E-05
6600	1.7134E-03	2.2972E-03	1.9591E-02	9.7438E-07	1.0939E-04	2.4018E-16	5.6936E-05
6800	1.3723E-03	1.8050E-03	1.5126E-02	2.2355E-06	2.3579E-04	2.0083E-16	1.3267E-04
7000	1.1027E-03	1.4243E-03	1.1740E-02	4.7878E-06	4.7615E-04	1.6859E-16	2.8308E-04
7200	8.5650E-04	1.0876E-03	8.8256E-03	9.6195E-06	9.0498E-04	1.2655E-16	5.7727E-04
7400	7.3260E-04	9.1534E-04	7.3190E-03	1.8211E-05	1.6256E-03	1.2433E-16	9.9417E-04
7600	6.2641E-04	7.7077E-04	6.0774E-03	3.2705E-05	2.7776E-03	1.1452E-16	1.6224E-03
7800	5.6021E-04	6.7937E-04	5.2860E-03	5.6046E-05	4.5404E-03	1.1328E-16	2.4135E-03
8000	5.2690E-04	6.3021E-04	4.8421E-03	9.2202E-05	7.1417E-03	1.2168E-16	3.2856E-03
8200	5.1976E-04	6.1357E-04	4.6581E-03	1.4641E-04	1.0867E-02	1.4143E-16	4.1350E-03
8400	5.3458E-04	6.2322E-04	4.6776E-03	2.2547E-04	1.6069E-02	1.7554E-16	4.8775E-03
8600	5.6562E-04	6.5159E-04	4.8375E-03	3.3803E-04	2.3175E-02	2.2796E-16	5.4785E-03
8800	6.0836E-04	6.9290E-04	5.0910E-03	4.9489E-04	3.2697E-02	3.0439E-16	5.9361E-03
9000	6.6393E-04	7.4801E-04	5.4416E-03	7.0926E-04	4.5232E-02	4.1374E-16	6.2559E-03
9200	7.2940E-04	8.1326E-04	5.8603E-03	9.9701E-04	6.1470E-02	5.6662E-16	6.4610E-03
9400	8.0369E-04	8.8722E-04	6.3354E-03	1.3768E-03	8.2180E-02	7.7699E-16	6.5704E-03
9600	8.8327E-04	9.6581E-04	6.8366E-03	1.8701E-03	1.0822E-01	1.0618E-15	6.6037E-03
9800	9.7230E-04	1.0535E-03	7.3950E-03	2.5012E-03	1.4050E-01	1.4438E-15	6.5706E-03
10000	1.0639E-03	1.1427E-03	7.9570E-03	3.2971E-03	1.7999E-01	1.9474E-15	6.4867E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN -
TOTAL PRESSURE = 1.0000 ATM
B = 5.000E-02

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	2.3703E-07	1.4253E-06	4.7891E-05	4.4115E-38	6.5020E-34	4.0147E-21	1.1332E-34
2200	1.8857E-06	9.3228E-06	2.6196E-04	5.8581E-34	4.5701E-30	3.9605E-20	6.5763E-31
2400	1.0527E-05	4.4210E-05	1.0702E-03	1.5903E-30	7.3013E-27	2.6651E-19	8.9024E-28
2600	4.4731E-05	1.6364E-04	3.4921E-03	1.2734E-27	3.7333E-24	1.3351E-18	3.9377E-25
2800	1.5325E-04	4.9809E-04	9.5400E-03	3.9083E-25	7.8003E-22	5.2958E-18	7.2411E-23
3000	4.4116E-04	1.2942E-03	2.2570E-02	5.5704E-23	7.9667E-20	1.7392E-17	6.6081E-21
3200	1.0998E-03	2.9495E-03	4.7392E-02	4.2577E-21	4.5492E-18	4.8862E-17	3.4184E-19
3400	2.4279E-03	6.0157E-03	8.9914E-02	1.9483E-19	1.6094E-16	1.2030E-16	1.1101E-17
3600	4.8213E-03	1.1134E-02	1.5605E-01	5.8137E-18	3.8208E-15	2.6407E-16	2.4519E-16
3800	8.7225E-03	1.8914E-02	2.5028E-01	1.2104E-16	6.4828E-14	5.2409E-16	3.9226E-15
4000	1.4489E-02	2.9687E-02	3.7301E-01	1.8554E-15	8.2662E-13	9.4872E-16	4.7851E-14
4200	2.2250E-02	4.3310E-02	5.1928E-01	2.1875E-14	8.2498E-12	1.5785E-15	4.6377E-13
4400	3.1747E-02	5.8985E-02	6.7773E-01	2.0553E-13	6.6618E-11	2.4279E-15	3.6943E-12
4600	4.2110E-02	7.4978E-02	8.2864E-01	1.5846E-12	4.4729E-10	3.4556E-15	2.4909E-11
4800	5.2187E-02	8.9366E-02	9.5307E-01	1.0271E-11	2.5539E-09	4.5767E-15	1.4529E-10
5000	6.1067E-02	1.0089E-01	1.0412E+00	5.7097E-11	1.2634E-08	5.7025E-15	7.4409E-10
5200	6.6969E-02	1.0703E-01	1.0717E+00	2.7685E-10	5.5008E-08	6.6371E-15	3.4140E-09
5400	6.9542E-02	1.0779E-01	1.0494E+00	1.1873E-09	2.1352E-07	7.2928E-15	1.4149E-08
5600	6.8768E-02	1.0359E-01	9.8273E-01	4.5555E-09	7.4684E-07	7.6104E-15	5.3378E-08
5800	6.5133E-02	9.5550E-02	8.8472E-01	1.5790E-08	2.3749E-06	7.5876E-15	1.8435E-07
6000	5.9408E-02	8.5022E-02	7.6963E-01	4.9829E-08	6.9154E-06	7.2687E-15	5.8500E-07
6200	5.1855E-02	7.2513E-02	6.4266E-01	1.4413E-07	1.8553E-05	6.6496E-15	1.7200E-06
6400	4.4546E-02	6.0956E-02	5.2962E-01	3.8411E-07	4.6076E-05	5.9756E-15	4.6358E-06
6600	3.7423E-02	5.0175E-02	4.2790E-01	9.4762E-07	1.0638E-04	5.2420E-15	1.1527E-05
6800	3.0609E-02	4.0259E-02	3.3737E-01	2.1736E-06	2.2926E-04	4.4683E-15	2.6587E-05
7000	2.5097E-02	3.2417E-02	2.6720E-01	4.6540E-06	4.6284E-04	3.8154E-15	5.6224E-05
7200	2.0527E-02	2.6065E-02	2.1152E-01	9.3468E-06	8.7932E-04	3.2339E-15	1.0996E-04
7400	1.6742E-02	2.0918E-02	1.6726E-01	1.7702E-05	1.5801E-03	2.7225E-15	2.0024E-04
7600	1.3901E-02	1.7104E-02	1.3486E-01	3.1801E-05	2.7008E-03	2.3062E-15	3.3946E-04
7800	1.1502E-02	1.3949E-02	1.0853E-01	5.4559E-05	4.4199E-03	1.8892E-15	5.4947E-04
8000	9.4295E-03	1.1278E-02	8.6656E-02	8.9995E-05	6.9708E-03	1.4109E-15	8.7207E-04
8200	9.1228E-03	1.0769E-02	8.1758E-02	1.4252E-04	1.0578E-02	1.7588E-15	1.1111E-03
8400	8.2313E-03	9.5961E-03	7.2024E-02	2.1970E-04	1.5657E-02	1.6684E-15	1.5022E-03
8600	7.5736E-03	8.7248E-03	6.4774E-02	3.2976E-04	2.2607E-02	1.6287E-15	1.9505E-03
8800	7.1100E-03	8.0980E-03	5.9499E-02	4.8337E-04	3.1935E-02	1.6419E-15	2.4382E-03
9000	6.8125E-03	7.6752E-03	5.5835E-02	6.9358E-04	4.4233E-02	1.7141E-15	2.9392E-03
9200	6.6592E-03	7.4248E-03	5.3503E-02	9.7609E-04	6.0180E-02	1.8542E-15	3.4234E-03
9400	6.6301E-03	7.3191E-03	5.2263E-02	1.3493E-03	8.0537E-02	2.0742E-15	3.8623E-03
9600	6.7065E-03	7.3332E-03	5.1909E-02	1.8343E-03	1.0615E-01	2.3895E-15	4.2354E-03
9800	6.8707E-03	7.4442E-03	5.2256E-02	2.4552E-03	1.3791E-01	2.8191E-15	4.5308E-03
10000	7.1424E-03	7.6709E-03	5.3417E-02	3.2384E-03	1.7678E-01	3.3950E-15	4.7395E-03

Table AVI. Number densities (cm^{-3}) as a function of temperature computed for one atm air plasmas seeded with potassium at seven different mass ratios.

PARTICLE NUMBER DENSITIES

- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -

TOTAL PRESSURE = 1.0000 ATM

NIT/OXY = 3.2917 B = 0.

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	0.	2.8842E+18	2.9176E+09	0.	4.2590E-07	1.6740E-13	7.5535E+17	1.1055E+15
2200	0.	2.6125E+18	3.6560E+10	0.	1.1156E-04	3.5142E-10	6.7650E+17	4.0321E+15
2400	0.	2.3819E+18	2.9871E+11	0.	1.1525E-02	2.0762E-07	6.0556E+17	1.1715E+16
2600	0.	2.1811E+18	-1.7558E+12	0.	5.9689E-01	4.6316E-05	5.3782E+17	2.8471E+16
2800	0.	2.0018E+18	7.9630E+12	0.	1.7614E+01	4.8189E-03	4.6874E+17	5.9754E+16
3000	0.	1.8373E+18	2.9326E+13	0.	3.3484E+02	2.7347E-01	3.9501E+17	1.1050E+17
3200	0.	1.6844E+18	9.1137E+13	0.	4.4766E+03	9.5389E+00	3.1586E+17	1.8206E+17
3400	0.	1.5431E+18	2.4633E+14	0.	4.5127E+04	2.2451E+02	2.3474E+17	2.6874E+17
3600	0.	1.4165E+18	5.9346E+14	0.	3.6278E+05	3.8365E+03	1.5951E+17	3.5681E+17
3800	0.	1.3084E+18	1.3009E+15	0.	2.4285E+06	5.0334E+04	9.8833E+16	4.2972E+17
4000	0.	1.2194E+18	2.6366E+15	0.	1.3933E+07	5.2732E+05	5.6880E+16	4.7744E+17
4200	0.	1.1462E+18	4.9990E+15	0.	6.9687E+07	4.5308E+06	3.1423E+16	5.0065E+17
4400	0.	1.0840E+18	8.9426E+15	0.	3.0718E+08	3.2574E+07	1.7209E+16	5.0610E+17
4600	0.	1.0282E+18	1.5192E+16	0.	1.2046E+09	1.9939E+08	9.5514E+15	5.0083E+17
4800	0.	9.7567E+17	2.4643E+16	0.	4.2427E+09	1.0563E+09	5.4320E+15	4.8955E+17
5000	0.	9.2404E+17	3.8336E+16	0.	1.3550E+10	4.9169E+09	3.1761E+15	4.7489E+17
5200	0.	8.7144E+17	5.7409E+16	0.	3.9578E+10	2.0385E+10	1.9087E+15	4.5822E+17
5400	0.	8.1637E+17	8.2988E+16	0.	1.0652E+11	7.6181E+10	1.1759E+15	4.4018E+17
5600	0.	7.5762E+17	1.1605E+17	0.	2.6584E+11	2.5932E+11	7.3997E+14	4.2101E+17
5800	0.	6.9436E+17	1.5721E+17	0.	6.1824E+11	8.1128E+11	4.7402E+14	4.0084E+17
6000	0.	6.2633E+17	2.0650E+17	0.	1.3451E+12	2.3501E+12	3.0799E+14	3.7975E+17
6200	0.	5.5400E+17	2.6312E+17	0.	2.7454E+12	6.3485E+12	2.0244E+14	3.5793E+17
6400	0.	4.7870E+17	3.2523E+17	0.	5.2668E+12	1.6068E+13	1.3435E+14	3.3568E+17
6600	0.	4.0266E+17	3.8998E+17	0.	9.5074E+12	3.8273E+13	9.0001E+13	3.1349E+17
6800	0.	3.2879E+17	4.5368E+17	0.	1.6163E+13	8.6103E+13	6.0948E+13	2.9198E+17
7000	0.	2.6024E+17	5.1237E+17	0.	2.5912E+13	1.8348E+14	4.1841E+13	2.7179E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	1.6103E+01	3.1246E-06	2.9389E+16	3.4535E+06	3.4535E+06	3.6701E+18	3.4535E+06	0.
2200	6.9711E+02	1.1562E-03	4.3425E+16	5.1494E+07	5.1494E+07	3.3364E+18	5.1494E+07	0.
2400	1.5999E+04	1.5993E-01	5.9243E+16	4.8844E+08	4.8844E+08	3.0584E+18	4.8846E+08	0.
2600	2.2401E+05	1.0356E+01	7.5694E+16	3.2636E+09	3.2636E+09	2.8231E+18	3.2638E+09	0.
2800	2.1067E+06	3.6816E+02	9.1215E+16	1.6495E+10	1.6495E+10	2.6215E+18	1.6497E+10	0.
3000	1.4213E+07	8.0655E+03	1.0383E+17	6.6325E+10	6.6325E+10	2.4467E+18	6.6339E+10	0.
3200	7.1842E+07	1.1850E+05	1.1135E+17	2.1997E+11	2.1997E+11	2.2938E+18	2.2004E+11	0.
3400	2.8263E+08	1.2432E+06	1.1202E+17	6.1780E+11	6.1780E+11	2.1589E+18	6.1809E+11	0.
3600	8.5799E+08	9.7733E+06	1.0547E+17	1.5007E+12	1.5007E+12	2.0389E+18	1.5015E+12	0.
3800	2.1207E+09	5.9932E+07	9.3329E+16	3.2153E+12	3.2153E+12	1.9316E+18	3.2175E+12	0.
4000	4.3749E+09	2.9759E+08	7.8674E+16	6.2043E+12	6.2043E+12	1.8350E+18	6.2089E+12	0.
4200	7.8584E+09	1.2398E+09	6.4354E+16	1.1007E+13	1.1007E+13	1.7476E+18	1.1016E+13	0.
4400	1.2780E+10	4.4695E+09	5.1947E+16	1.8274E+13	1.8274E+13	1.6682E+18	1.8291E+13	0.
4600	1.9377E+10	1.4289E+10	4.1842E+16	2.8771E+13	2.8771E+13	1.5957E+18	2.8806E+13	0.
4800	2.7907E+10	4.1281E+10	3.3812E+16	4.3354E+13	4.3354E+13	1.5292E+18	4.3428E+13	0.
5000	3.8617E+10	1.0931E+11	2.7459E+16	6.2912E+13	6.2912E+13	1.4680E+18	6.3079E+13	0.
5200	5.1728E+10	2.6837E+11	2.2400E+16	8.8306E+13	8.8306E+13	1.4116E+18	8.8686E+13	0.
5400	6.7376E+10	6.1649E+11	1.8326E+16	1.2026E+14	1.2026E+14	1.3593E+18	1.2113E+14	0.
5600	8.5630E+10	1.3355E+12	1.4998E+16	1.5924E+14	1.5924E+14	1.3107E+18	1.6119E+14	0.
5800	1.0644E+11	2.7467E+12	1.2246E+16	2.0533E+14	2.0533E+14	1.2655E+18	2.0961E+14	0.
6000	1.2968E+11	5.3951E+12	9.9460E+15	2.5807E+14	2.5807E+14	1.2234E+18	2.6729E+14	0.
6200	1.5520E+11	1.0175E+13	8.0132E+15	3.1645E+14	3.1645E+14	1.1839E+18	3.3587E+14	0.
6400	1.8294E+11	1.8521E+13	6.3889E+15	3.7883E+14	3.7883E+14	1.1469E+18	4.1886E+14	0.
6600	2.1308E+11	3.2690E+13	5.0331E+15	4.4314E+14	4.4314E+14	1.1122E+18	5.2382E+14	0.
6800	2.4620E+11	5.6209E+13	3.9161E+15	5.0719E+14	5.0719E+14	1.0796E+18	6.6591E+14	0.
7000	2.8353E+11	9.4543E+13	3.0126E+15	5.6901E+14	5.6901E+14	1.0489E+18	8.7323E+14	0.

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917   B = 1.000E-04

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	2.722[illegible]E+14	2.9[illegible]77E+18	2.9294E+09	8.2301E+11	1.8017E-12	7.0528E-19	7.6149E+17	1.1100E+15
2200	2.4672E+14	2.6471E+18	3.6802E+10	2.6438E+12	2.2018E-09	6.8901E-15	6.8549E+17	4.0588E+15
2400	2.1841E+14	2.3820E+18	2.9872E+11	6.8909E+12	8.2404E-07	1.4717E-11	6.0553E+17	1.1715E+16
2600	1.9191E+14	2.1809E+18	1.7557E+12	1.5364E+13	1.2677E-04	9.6376E-09	5.3770E+17	2.8468E+16
2800	1.6153E+14	2.0016E+18	7.9627E+12	2.9728E+13	9.7722E-03	2.6737E-06	4.6873E+17	5.9753E+16
3000	1.2621E+14	1.8374E+18	2.9326E+13	5.0295E+13	4.4156E-01	3.6063E-04	3.9502E+17	1.1050E+17
3200	8.8274E+13	1.6844E+18	9.1136E+13	7.4289E+13	1.3255E+01	2.8244E-02	3.1587E+17	1.8207E+17
3400	5.3766E+13	1.5434E+18	2.4632E+14	9.5686E+13	2.9133E+02	1.4494E+00	2.3472E+17	2.6873E+17
3600	2.8690E+13	1.4164E+18	5.9343E+14	1.0858E+14	5.0123E+03	5.3010E+01	1.5949E+17	3.5679E+17
3800	1.4274E+13	1.3083E+18	1.3008E+15	1.1236E+14	6.9430E+04	1.4391E+03	9.8818E+16	4.2968E+17
4000	7.2223E+12	1.2193E+18	2.6365E+15	1.1048E+14	7.7995E+05	2.9519E+04	5.6870E+16	4.7740E+17
4200	3.9597E+12	1.1461E+18	4.9987E+15	1.0635E+14	7.1358E+06	4.6397E+05	3.1417E+16	5.0060E+17
4400	2.4826E+12	1.0839E+18	8.9421E+15	1.0162E+14	5.3552E+07	5.6791E+06	1.7206E+16	5.0606E+17
4600	1.7048E+12	1.0281E+18	1.5192E+16	9.7007E+13	3.3035E+08	5.4687E+07	9.5500E+15	5.0080E+17
4800	1.3200E+12	9.7557E+17	2.4641E+16	9.2551E+13	1.6768E+09	4.1749E+08	5.4313E+15	4.8952E+17
5000	1.0632E+12	9.2395E+17	3.8334E+16	8.8327E+13	7.0430E+09	2.5558E+09	3.1758E+15	4.7487E+17
5200	9.5893E+11	8.7136E+17	5.7406E+16	8.4173E+13	2.4979E+10	1.2866E+10	1.9085E+15	4.5821E+17
5400	8.7454E+11	8.1630E+17	8.2984E+16	8.0118E+13	7.6790E+10	5.4919E+10	1.1758E+15	4.4017E+17
5600	8.1677E+11	7.5755E+17	1.1604E+17	7.6081E+13	2.0980E+11	2.0466E+11	7.3993E+14	4.2100E+17
5800	7.6735E+11	6.9430E+17	1.5720E+17	7.2012E+13	5.1923E+11	6.8138E+11	4.7400E+14	4.0083E+17
6000	7.5584E+11	6.2627E+17	2.0649E+17	6.7872E+13	1.1797E+12	2.0613E+12	3.0798E+14	3.7975E+17
6200	6.9773E+11	5.5395E+17	2.6310E+17	6.3730E+13	2.4827E+12	5.7412E+12	2.0243E+14	3.5792E+17
6400	6.6989E+11	4.7866E+17	3.2522E+17	5.9553E+13	4.8688E+12	1.4854E+13	1.3434E+14	3.3568E+17
6600	6.3248E+11	4.0262E+17	3.8996E+17	5.5452E+13	8.9306E+12	3.5952E+13	8.9999E+13	3.1349E+17
6800	5.8717E+11	3.2876E+17	4.5365E+17	5.1526E+13	1.5362E+13	8.1839E+13	6.0947E+13	2.9197E+17
7000	5.3703E+11	2.6122E+17	5.1234E+17	4.7881E+13	2.4843E+13	1.7592E+14	4.1841E+13	2.7179E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	6.8119E-05	1.3164E-11	2.9628E+16	1.4609E+01	8.2301E+11	3.7002E+18	8.2301E+11	7.439E-05
2200	1.3758E-02	2.2668E-08	4.4001E+16	1.0163E+03	2.6438E+12	3.3809E+18	2.6438E+12	7.474E-05
2400	1.1340E+00	1.1336E-05	5.9243E+16	3.4622E+04	6.8909E+12	3.0587E+18	6.8909E+12	7.367E-05
2600	4.7571E+01	2.1994E-03	7.5681E+16	6.9311E+05	1.5364E+13	2.8229E+18	1.5364E+13	7.342E-05
2800	1.1689E+03	2.0427E-01	9.1210E+16	9.1515E+06	2.9728E+13	2.6215E+18	2.9728E+13	7.296E-05
3000	1.8743E+04	1.0636E+01	1.0383E+17	8.7465E+07	5.0295E+13	2.4470E+18	5.0295E+13	7.214E-05
3200	2.1273E+05	3.5088E+02	1.1135E+17	6.5132E+08	7.4290E+13	2.2940E+18	7.4290E+13	7.087E-05
3400	1.8246E+06	8.0260E+03	1.1201E+17	3.9884E+09	9.5690E+13	2.1590E+18	9.5690E+13	6.920E-05
3600	1.1854E+07	1.3504E+05	1.0546E+17	2.0734E+10	1.0860E+14	2.0390E+18	1.0860E+14	6.733E-05
3800	6.0626E+07	1.7135E+06	9.3317E+16	9.1923E+10	1.1245E+14	1.9316E+18	1.1245E+14	6.556E-05
4000	2.4488E+08	1.6659E+07	7.8663E+16	3.4728E+11	1.1082E+14	1.8350E+18	1.1082E+14	6.414E-05
4200	8.0463E+08	1.2696E+08	6.4345E+16	1.1270E+12	1.0748E+14	1.7477E+18	1.0748E+14	6.312E-05
4400	2.2280E+09	7.7921E+08	5.1940E+16	3.1857E+12	1.0481E+14	1.6682E+18	1.0481E+14	6.240E-05
4600	5.3140E+09	3.9190E+09	4.1837E+16	7.8904E+12	1.0490E+14	1.5957E+18	1.0491E+14	6.186E-05
4800	1.1029E+10	1.6316E+10	3.3808E+16	1.7134E+13	1.0968E+14	1.5292E+18	1.0971E+14	6.139E-05
5000	2.0072E+10	5.6821E+10	2.7457E+16	3.2700E+13	1.2103E+14	1.4680E+18	1.2111E+14	6.089E-05
5200	3.2647E+10	1.6939E+11	2.2398E+16	5.5733E+13	1.3991E+14	1.4116E+18	1.4015E+14	6.031E-05
5400	4.8571E+10	4.4444E+11	1.8324E+16	8.6693E+13	1.6681E+14	1.3593E+18	1.6744E+14	5.959E-05
5600	6.7581E+10	1.0541E+12	1.4997E+16	1.2568E+14	2.0176E+14	1.3107E+18	2.0329E+14	5.867E-05
5800	8.9395E+10	2.3070E+12	1.2245E+16	1.7245E+14	2.4446E+14	1.2655E+18	2.4806E+14	5.751E-05
6000	1.1375E+11	4.7321E+12	9.9454E+15	2.2635E+14	2.9422E+14	1.2234E+18	3.0231E+14	5.610E-05
6200	1.4036E+11	9.2022E+12	8.0128E+15	2.8618E+14	3.4991E+14	1.1839E+18	3.6747E+14	5.442E-05
6400	1.6913E+11	1.7122E+13	6.3886E+15	3.5021E+14	4.0976E+14	1.1469E+18	4.4678E+14	5.251E-05
6600	2.0016E+11	3.0709E+13	5.0328E+15	4.1627E+14	4.7172E+14	1.1122E+18	5.4751E+14	5.043E-05
6800	2.3402E+11	5.3427E+13	3.9159E+15	4.8207E+14	5.3359E+14	1.0796E+18	6.8446E+14	4.828E-05
7000	2.7186E+11	9.0651E+13	3.0124E+15	5.4556E+14	5.9344E+14	1.0489E+18	8.8513E+14	4.617E-05

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917 B = 5.000E-04

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	1.3644E+15	2.9088E+18	2.9300E+09	1.8426E+12	8.0506E-13	3.1508E-19	7.6172E+17	1.1102E+15
2200	1.2417E+15	2.6479E+18	3.6808E+10	5.9311E+12	9.8173E-10	3.0717E-15	6.8568E+17	4.0594E+15
2400	1.1340E+15	2.4298E+18	3.0170E+11	1.5701E+13	3.6891E-07	6.5236E-12	6.1783E+17	1.1833E+16
2600	1.0021E+15	2.1818E+18	1.7560E+12	3.5114E+13	5.5493E-05	4.3054E-09	5.3794E+17	2.8474E+16
2800	8.8723E+14	2.0022E+18	7.9638E+12	6.9699E+13	4.1692E-03	1.1405E-06	4.6886E+17	5.9762E+16
3000	7.5945E+14	1.8377E+18	2.9329E+13	1.2349E+14	1.7988E-01	1.4690E-04	3.9512E+17	1.1051E+17
3200	6.1644E+14	1.6640E+18	9.1142E+13	1.9680E+14	5.0040E+00	1.0662E-02	3.1590E+17	1.8207E+17
3400	4.6446E+14	1.5430E+18	2.4632E+14	2.8280E+14	9.8578E+01	4.9044E-01	2.3474E+17	2.6874E+17
3600	3.1958E+14	1.4162E+18	5.9339E+14	3.6696E+14	1.4832E+03	1.5687E+01	1.5947E+17	3.5676E+17
3800	2.0064E+14	1.3080E+18	1.3007E+15	4.3263E+14	1.8041E+04	3.7400E+02	9.8782E+16	4.2961E+17
4000	1.1781E+14	1.2188E+18	2.6360E+15	4.7072E+14	1.8353E+05	6.9475E+03	5.6839E+16	4.7727E+17
4200	6.7435E+13	1.1456E+18	4.9977E+15	4.8411E+14	1.5828E+06	1.0293E+05	3.1396E+16	5.0043E+17
4400	3.9231E+13	1.0534E+18	8.9402E+15	4.8127E+14	1.1640E+07	1.2347E+06	1.7192E+16	5.0586E+17
4600	2.4272E+13	1.0276E+18	1.5188E+16	4.6926E+14	7.3538E+07	1.2176E+07	9.5421E+15	5.0059E+17
4800	1.6153E+13	9.7513E+17	2.4636E+16	4.5317E+14	4.0202E+08	1.0012E+08	5.4268E+15	4.8932E+17
5000	1.1246E+13	9.2353E+17	3.8326E+16	4.3567E+14	1.9165E+09	6.9561E+08	3.1733E+15	4.7468E+17
5200	8.6477E+12	8.7098E+17	5.7393E+16	4.1699E+14	8.0320E+09	4.1380E+09	1.9071E+15	4.5804E+17
5400	7.1176E+12	8.1595E+17	8.2966E+16	3.9782E+14	2.9685E+10	2.1235E+10	1.1750E+15	4.4002E+17
5600	5.9223E+12	7.5723E+17	1.1602E+17	3.7853E+14	9.6914E+10	9.4561E+10	7.3952E+14	4.2089E+17
5800	5.1500E+12	6.9402E+17	1.5717E+17	3.5873E+14	2.8073E+11	3.6847E+11	4.7378E+14	4.0074E+17
6000	4.6497E+12	6.2603E+17	2.0645E+17	3.3849E+14	7.2614E+11	1.2690E+12	3.0786E+14	3.7967E+17
6200	4.0433E+12	5.5374E+17	2.6305E+17	3.1809E+14	1.6922E+12	3.9140E+12	2.0237E+14	3.5787E+17
6400	3.7824E+12	4.7847E+17	3.2516E+17	2.9733E+14	3.5897E+12	1.0954E+13	1.3431E+14	3.3564E+17
6600	3.3453E+12	4.0247E+17	3.8989E+17	2.7708E+14	6.9864E+12	2.8131E+13	8.9982E+13	3.1346E+17
6800	3.1565E+12	3.2863E+17	4.5357E+17	2.5741E+14	1.2570E+13	6.6974E+13	6.0939E+13	2.9195E+17
7000	2.7757E+12	2.6412E+17	5.1224E+17	2.3931E+14	2.1022E+13	1.4889E+14	4.1837E+13	2.7177E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	3.0435E-05	5.8809E-12	2.9638E+16	6.5276E+00	1.8426E+12	3.7027E+18	1.8426E+12	3.723E-04
2200	6.1345E-03	1.0100E-08	4.4014E+16	4.5314E+02	5.9311E+12	3.3829E+18	5.9311E+12	3.739E-04
2400	5.0778E-01	5.0252E-06	6.0439E+16	1.5502E+04	1.5701E+13	3.1211E+18	1.5701E+13	3.759E-04
2600	2.0824E+01	9.6258E-04	7.5714E+16	3.0340E+05	3.5114E+13	2.8250E+18	3.5114E+13	3.674E-04
2800	4.9870E+02	8.7137E-02	9.1236E+16	3.9044E+06	6.9699E+13	2.6231E+18	6.9699E+13	3.650E-04
3000	7.6358E+03	4.3326E+00	1.0385E+17	3.5631E+07	1.2349E+14	2.4482E+18	1.2349E+14	3.609E-04
3200	8.0305E+04	1.3246E+02	1.1137E+17	2.4589E+08	1.9680E+14	2.2950E+18	1.9680E+14	3.545E-04
3400	6.1742E+05	2.7158E+03	1.1202E+17	1.3496E+09	2.8281E+14	2.1598E+18	2.8281E+14	3.461E-04
3600	3.5077E+06	3.9961E+04	1.0545E+17	6.1352E+09	3.6697E+14	2.0396E+18	3.6697E+14	3.367E-04
3800	1.5752E+07	4.4528E+05	9.3289E+16	2.3885E+10	4.3265E+14	1.9320E+18	4.3265E+14	3.278E-04
4000	5.7611E+07	3.9203E+06	7.8628E+16	8.1713E+10	4.7080E+14	1.8353E+18	4.7080E+14	3.207E-04
4200	1.7042E+08	2.8162E+07	6.4309E+16	2.4995E+11	4.8436E+14	1.7478E+18	4.8436E+14	3.156E-04
4400	4.8411E+08	1.6938E+08	5.1908E+16	6.9234E+11	4.8196E+14	1.6683E+18	4.8197E+14	3.120E-04
4600	1.1825E+09	8.7241E+08	4.1810E+16	1.7561E+12	4.7101E+14	1.5957E+18	4.7102E+14	3.093E-04
4800	2.6433E+09	3.9119E+09	3.3786E+16	4.1072E+12	4.5728E+14	1.5292E+18	4.5728E+14	3.069E-04
5000	5.4599E+09	1.5462E+10	2.7440E+16	8.8964E+12	4.4457E+14	1.4680E+18	4.4459E+14	3.044E-04
5200	1.0494E+10	5.4470E+10	2.2385E+16	1.7918E+13	4.3490E+14	1.4116E+18	4.3498E+14	3.015E-04
5400	1.8772E+10	1.7182E+11	1.8314E+16	3.3509E+13	4.3133E+14	1.3593E+18	4.3158E+14	2.979E-04
5600	3.1214E+10	4.8698E+11	1.4590E+16	5.8050E+13	4.3658E+14	1.3107E+18	4.3729E+14	2.933E-04
5800	4.8329E+10	1.2475E+12	1.2240E+16	9.3232E+13	4.5197E+14	1.2656E+18	4.5391E+14	2.875E-04
6000	7.0014E+10	2.9133E+12	9.9415E+15	1.3933E+14	4.7781E+14	1.2234E+18	4.8279E+14	2.805E-04
6200	9.5677E+10	6.2737E+12	8.0100E+15	1.9507E+14	5.1316E+14	1.1839E+18	5.2513E+14	2.721E-04
6400	1.2471E+11	1.2627E+13	6.3665E+15	2.5822E+14	5.5555E+14	1.1469E+18	5.8285E+14	2.625E-04
6600	1.5662E+11	2.4031E+13	5.0314E+15	3.2568E+14	6.0276E+14	1.1122E+18	6.6206E+14	2.521E-04
6800	1.9152E+11	4.3728E+13	3.9149E+15	3.9448E+14	6.5190E+14	1.0796E+18	7.7536E+14	2.414E-04
7000	2.3011E+11	7.6735E+13	3.0117E+15	4.6172E+14	7.0103E+14	1.0488E+18	9.4791E+14	2.309E-04

PARTICLE NUMBER DENSITIES

- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -

TOTAL PRESSURE = 1.0000 ATM

NIT/OXY = 3.2917   B = 1.000E-03

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	2.7373E+15	2.9099E+18	2.9305E+09	2.6075E+12	5.6910E-13	2.2269E-19	7.6199E+17	1.1104E+15
2200	2.4890E+15	2.6488E+18	3.6814E+10	8.3973E+12	6.9365E-10	2.1699E-15	6.8592E+17	4.0601E+15
2400	2.2790E+15	2.4307E+18	3.0176E+11	2.2260E+13	2.6031E-07	4.6024E-12	6.1806E+17	1.1835E+16
2600	2.0266E+15	2.1827E+18	1.7564E+12	4.9938E+13	3.9036E-05	3.0280E-09	5.3816E+17	2.8480E+16
2800	1.8158E+15	2.0030E+18	7.9654E+12	9.9723E+13	2.9151E-03	7.9731E-07	4.6906E+17	5.9774E+16
3000	1.5888E+15	1.8382E+18	2.9333E+13	1.7865E+14	1.2437E-01	1.0155E-04	3.9524E+17	1.1053E+17
3200	1.3377E+15	1.6850E+18	9.1154E+13	2.9006E+14	3.3961E+00	7.2351E-03	3.1598E+17	1.8210E+17
3400	1.0665E+15	1.5432E+18	2.4634E+14	4.2904E+14	6.4987E+01	3.2330E-01	2.3478E+17	2.6876E+17
3600	7.9405E+14	1.4163E+18	5.9341E+14	5.7981E+14	9.3880E+02	9.9289E+00	1.5945E+17	3.5675E+17
3800	5.4845E+14	1.3078E+18	1.3006E+15	7.1857E+14	1.0861E+04	2.2517E+02	9.8765E+16	4.2957E+17
4000	3.5343E+14	1.2185E+18	2.6357E+15	8.2390E+14	1.0484E+05	3.9092E+03	5.6815E+16	4.7717E+17
4200	2.1760E+14	1.1452E+18	4.9968E+15	8.8560E+14	8.6520E+05	5.6277E+04	3.1375E+16	5.0026E+17
4400	1.3198E+14	1.0829E+18	8.9381E+15	9.0906E+14	6.1661E+06	6.5421E+05	1.7178E+16	5.0565E+17
4600	8.1214E+13	1.0271E+18	1.5184E+16	9.0582E+14	3.8181E+07	6.3230E+06	9.5329E+15	5.0035E+17
4800	5.2814E+13	9.7459E+17	2.4629E+16	8.8577E+14	2.0693E+08	5.1548E+07	5.4212E+15	4.8907E+17
5000	3.5484E+13	9.2301E+17	3.8315E+16	8.5829E+14	9.8686E+08	3.5830E+08	3.1699E+15	4.7442E+17
5200	2.5915E+13	8.7048E+17	5.7377E+16	8.2528E+14	4.1830E+09	2.1556E+09	1.9051E+15	4.5779E+17
5400	2.0085E+13	8.1548E+17	8.2943E+16	7.8973E+14	1.5845E+10	1.1338E+10	1.1738E+15	4.3979E+17
5600	1.6611E+13	7.5680E+17	1.1599E+17	7.5323E+14	5.3836E+10	5.2544E+10	7.3878E+14	4.2068E+17
5800	1.3253E+13	6.9363E+17	1.5713E+17	7.1446E+14	1.6486E+11	2.1645E+11	4.7334E+14	4.0055E+17
6000	1.1031E+13	6.2568E+17	2.0640E+17	6.7519E+14	4.5482E+11	7.9506E+11	3.0761E+14	3.7952E+17
6200	1.0004E+13	5.5344E+17	2.6298E+17	6.3423E+14	1.1345E+12	2.6248E+12	2.0222E+14	3.5774E+17
6400	8.7477E+12	4.7822E+17	3.2507E+17	5.9346E+14	2.5627E+12	7.8219E+12	1.3423E+14	3.3554E+17
6600	7.7665E+12	4.0226E+17	3.8979E+17	5.5307E+14	5.2696E+12	2.1224E+13	8.9939E+13	3.1339E+17
6800	6.9749E+12	3.2846E+17	4.5345E+17	5.1415E+14	9.9208E+12	5.2874E+13	6.0916E+13	2.9190E+17
7000	6.3199E+12	2.5999E+17	5.1211E+17	4.7785E+14	1.7210E+13	1.2192E+14	4.1825E+13	2.7174E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	2.1514E-05	4.1565E-12	2.9648E+16	4.6144E+00	2.6075E+12	3.7054E+18	2.6075E+12	7.452E-04
2200	4.3344E-03	7.1390E-09	4.4030E+16	3.2017E+02	8.3973E+12	3.3854E+18	8.3973E+12	7.485E-04
2400	3.5831E-01	3.5453E-06	6.0462E+16	1.0938E+04	2.2260E+13	3.1234E+18	2.2260E+13	7.525E-04
2600	1.4649E+01	6.7698E-04	7.5745E+16	2.1343E+05	4.9938E+13	2.8272E+18	4.9938E+13	7.355E-04
2800	3.4870E+02	6.0915E-02	9.1273E+16	2.7300E+06	9.9723E+13	2.6251E+18	9.9723E+13	7.307E-04
3000	5.2798E+03	2.9953E+00	1.0388E+17	2.4637E+07	1.7865E+14	2.4499E+18	1.7865E+14	7.224E-04
3200	5.4501E+04	8.9880E+01	1.1139E+17	1.6687E+08	2.9006E+14	2.2965E+18	2.9006E+14	7.096E-04
3400	4.0704E+05	1.7903E+03	1.1204E+17	8.8972E+08	4.2904E+14	2.1610E+18	4.2904E+14	6.927E-04
3600	2.2199E+06	2.5291E+04	1.0544E+17	3.8830E+09	5.7981E+14	2.0405E+18	5.7981E+14	6.738E-04
3800	9.4824E+06	2.6807E+05	9.3276E+16	1.4379E+10	7.1859E+14	1.9327E+18	7.1859E+14	6.559E-04
4000	3.2905E+07	2.2396E+06	7.8601E+16	4.6674E+10	8.2395E+14	1.8357E+18	8.2395E+14	6.416E-04
4200	9.7503E+07	1.5395E+07	6.4276E+16	1.3661E+11	8.8574E+14	1.7481E+18	8.8574E+14	6.313E-04
4400	2.5635E+08	8.9728E+07	5.1874E+16	3.6668E+11	9.0942E+14	1.6685E+18	9.0942E+14	6.240E-04
4600	6.1367E+08	4.5297E+08	4.1779E+16	9.1157E+11	9.0673E+14	1.5958E+18	9.0673E+14	6.186E-04
4800	1.3599E+09	2.0137E+09	3.3760E+16	2.1136E+12	8.8789E+14	1.5293E+18	8.8789E+14	6.138E-04
5000	2.8101E+09	7.9623E+09	2.7417E+16	4.5799E+12	8.6287E+14	1.4681E+18	8.6288E+14	6.088E-04
5200	5.4628E+09	2.8368E+10	2.2367E+16	9.3293E+12	8.3461E+14	1.4116E+18	8.3465E+14	6.030E-04
5400	1.0015E+10	9.1720E+10	1.8299E+16	1.7882E+13	8.0761E+14	1.3593E+18	8.0774E+14	5.958E-04
5600	1.7332E+10	2.7054E+11	1.4978E+16	3.2240E+13	7.8547E+14	1.3108E+18	7.8586E+14	5.866E-04
5800	2.8371E+10	7.3267E+11	1.2231E+16	5.4741E+13	7.6920E+14	1.2656E+18	7.7035E+14	5.750E-04
6000	4.3841E+10	1.8250E+12	9.9348E+15	8.7255E+13	7.6244E+14	1.2234E+18	7.6556E+14	5.609E-04
6200	6.4135E+10	4.2069E+12	8.0050E+15	1.3077E+14	7.6500E+14	1.1839E+18	7.7303E+14	5.442E-04
6400	8.9027E+10	9.0166E+12	6.3830E+15	1.8434E+14	7.7779E+14	1.1469E+18	7.9728E+14	5.251E-04
6600	1.1814E+11	1.8131E+13	5.0289E+15	2.4565E+14	7.9872E+14	1.1122E+18	8.4347E+14	5.043E-04
6800	1.5118E+11	3.4525E+13	3.9132E+15	3.1137E+14	8.2552E+14	1.0795E+18	9.2299E+14	4.828E-04
7000	1.8842E+11	6.2843E+13	3.0105E+15	3.7803E+14	8.5588E+14	1.0488E+18	1.0580E+15	4.617E-04

PARTICLE NUMBER DENSITIES

- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -

TOTAL PRESSURE = 1.0000 ATM

NIT/OXY = 3.2917 B = 5.000E-03

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	1.3760E+16	2.9193E+18	2.9352E+09	5.8515E+12	2.5442E-13	9.9395E-20	7.6459E+17	1.1123E+15
2200	1.2556E+16	2.6567E+18	3.6869E+10	1.8861E+13	3.0975E-10	9.6756E-16	6.8795E+17	4.0661E+15
2400	1.1537E+16	2.4380E+18	3.0221E+11	5.0085E+13	1.1604E-07	2.0486E-12	6.1993E+17	1.1853E+16
2600	1.0629E+16	2.2497E+18	1.7832E+12	1.1437E+14	1.7568E-05	1.3422E-09	5.5490E+17	2.8919E+16
2800	9.4163E+15	2.0086E+18	7.9766E+12	2.2712E+14	1.2836E-03	3.5057E-07	4.7042E+17	5.9861E+16
3000	8.4834E+15	1.8431E+18	2.9372E+13	4.1297E+14	5.3946E-02	4.3990E-05	3.9636E+17	1.1069E+17
3200	7.5036E+15	1.6691E+18	9.1264E+13	6.8750E+14	1.4363E+00	3.0563E-03	3.1683E+17	1.8234E+17
3400	6.4665E+15	1.5467E+18	2.4661E+14	1.0581E+15	2.6410E+01	1.3124E-01	2.3538E+17	2.6910E+17
3600	5.3913E+15	1.4182E+18	5.9381E+14	1.5155E+15	3.5967E+02	3.8014E+00	1.5976E+17	3.5709E+17
3800	4.3318E+15	1.3087E+18	1.3010E+15	2.0328E+15	3.8418E+03	7.9620E+01	9.8858E+16	4.2977E+17
4000	3.3443E+15	1.2182E+18	2.6353E+15	2.5643E+15	3.3677E+04	1.2752E+03	5.6789E+16	4.7706E+17
4200	2.4763E+15	1.1438E+18	4.9938E+15	3.0557E+15	2.5049E+05	1.6303E+04	3.1308E+16	4.9973E+17
4400	1.7651E+15	1.0806E+18	8.9288E+15	3.4500E+15	1.6220E+06	1.7226E+05	1.7113E+16	5.0469E+17
4600	1.2214E+15	1.0242E+18	1.5163E+16	3.7194E+15	9.2809E+06	1.5393E+06	9.4824E+15	4.9902E+17
4800	8.3214E+14	9.7126E+17	2.4587E+16	3.8634E+15	4.7389E+07	1.1825E+07	5.3860E+15	4.8748E+17
5000	5.6679E+14	9.1946E+17	3.8241E+16	3.9027E+15	2.1730E+08	7.9045E+07	3.1466E+15	4.7268E+17
5200	3.9075E+14	8.6687E+17	5.7258E+16	3.8646E+15	8.9915E+08	4.6433E+08	1.8900E+15	4.5598E+17
5400	2.8329E+14	8.1194E+17	8.2762E+16	3.7649E+15	3.3807E+09	2.4243E+09	1.1641E+15	4.3798E+17
5600	2.0532E+14	7.5341E+17	1.1573E+17	3.6378E+15	1.1550E+10	1.1298E+10	7.3257E+14	4.1890E+17
5800	1.5946E+14	6.9046E+17	1.5677E+17	3.4781E+15	3.6168E+10	4.7595E+10	4.6937E+14	3.9887E+17
6000	1.2118E+14	6.2278E+17	2.0592E+17	3.3085E+15	1.0370E+11	1.8171E+11	3.0507E+14	3.7795E+17
6200	9.9419E+13	5.5085E+17	2.6237E+17	3.1206E+15	2.7405E+11	6.3552E+11	2.0062E+14	3.5632E+17
6400	7.8004E+13	4.7596E+17	3.2430E+17	2.9322E+15	6.6571E+11	2.0367E+12	1.3322E+14	3.3427E+17
6600	6.6406E+13	4.0036E+17	3.8886E+17	2.7373E+15	1.4925E+12	6.0253E+12	8.9309E+13	3.1229E+17
6800	5.3357E+13	3.2690E+17	4.5237E+17	2.5521E+15	3.0774E+12	1.0441E+13	6.0526E+13	2.9097E+17
7000	4.6905E+13	2.5875E+17	5.1089E+17	2.3740E+15	5.8574E+12	4.1597E+13	4.1587E+13	2.7096E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	9.6199E-06	1.8553E-12	2.9747E+16	2.0831E+00	5.8515E+12	3.7285E+18	5.8515E+12	3.753E-03
2200	1.9355E-03	3.1832E-09	4.4160E+16	1.4297E+02	1.8861E+13	3.4055E+18	1.8861E+13	3.769E-03
2400	1.5973E-01	1.5780E-06	6.0644E+16	4.8761E+03	5.0085E+13	3.1421E+18	5.0085E+13	3.789E-03
2600	6.5949E+00	3.0015E-04	7.8086E+16	9.6068E+04	1.1437E+14	2.9225E+18	1.1437E+14	3.806E-03
2800	1.5355E+02	2.6785E-02	9.1534E+16	1.2021E+06	2.2712E+14	2.6403E+18	2.2712E+14	3.679E-03
3000	2.2904E+03	1.2976E+00	1.0417E+17	1.0687E+07	4.1297E+14	2.4637E+18	4.1297E+14	3.636E-03
3200	2.3057E+04	3.7973E+01	1.1168E+17	7.0587E+07	6.8750E+14	2.3089E+18	6.8750E+14	3.571E-03
3400	1.6547E+05	7.2687E+02	1.1230E+17	3.6164E+08	1.0581E+15	2.1723E+18	1.0581E+15	3.485E-03
3600	8.5094E+05	9.6855E+03	1.0562E+17	1.4881E+09	1.5155E+15	2.0497E+18	1.5155E+15	3.387E-03
3800	3.3551E+06	9.4605E+04	9.3350E+16	5.0867E+09	2.0328E+15	1.9403E+18	2.0328E+15	3.295E-03
4000	1.0568E+07	7.1942E+05	7.8571E+16	1.4991E+10	2.5644E+15	1.8417E+18	2.5644E+15	3.220E-03
4200	2.8203E+07	4.4577E+06	6.4169E+16	3.9532E+10	3.0557E+15	1.7526E+18	3.0557E+15	3.165E-03
4400	6.7315E+07	2.3607E+07	5.1722E+16	9.6369E+10	3.4501E+15	1.6717E+18	3.4501E+15	3.126E-03
4600	1.4880E+08	1.1013E+08	4.1609E+16	2.2131E+11	3.7196E+15	1.5981E+18	3.7196E+15	3.096E-03
4800	3.1048E+08	4.6122E+08	3.3592E+16	4.8328E+11	3.8639E+15	1.5309E+18	3.8639E+15	3.071E-03
5000	6.1658E+08	1.7535E+09	2.7264E+16	1.0067E+12	3.9037E+15	1.4692E+18	3.9037E+15	3.045E-03
5200	1.1698E+09	6.0990E+09	2.2232E+16	2.0016E+12	3.8666E+15	1.4123E+18	3.8666E+15	3.015E-03
5400	2.1285E+09	1.9574E+10	1.8184E+16	3.8079E+12	3.7688E+15	1.3598E+18	3.7688E+15	2.978E-03
5600	3.7039E+09	5.8058E+10	1.4882E+16	6.9033E+12	3.6447E+15	1.3111E+18	3.6448E+15	2.932E-03
5800	6.2005E+09	1.6080E+11	1.2152E+16	1.1987E+13	3.4901E+15	1.2659E+18	3.4903E+15	2.874E-03
6000	9.9601E+09	4.1634E+11	9.8707E+15	1.9859E+13	3.3283E+15	1.2236E+18	3.3290E+15	2.803E-03
6200	1.5441E+10	1.0169E+12	7.9544E+15	3.1536E+13	3.1522E+15	1.1841E+18	3.1541E+15	2.720E-03
6400	2.3061E+10	2.3445E+12	6.3438E+15	4.7818E+13	2.9800E+15	1.1471E+18	2.9851E+15	2.625E-03
6600	3.3382E+10	5.1413E+12	4.9993E+15	6.9495E+13	2.8068E+15	1.1123E+18	2.8195E+15	2.521E-03
6800	4.6820E+10	1.0726E+13	3.8913E+15	9.6508E+13	2.6486E+15	1.0796E+18	2.6789E+15	2.414E-03
7000	6.4072E+10	2.1430E+13	2.9947E+15	1.2861E+14	2.5027E+15	1.0488E+18	2.5716E+15	2.309E-03

PARTICLE NUMBER DENSITIES

- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -

TOTAL PRESSURE = 1.0000 ATM

NIT/OXY = 3.2917 B = 1.000E-02

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	2.7818E+16	2.9342E+18	2.9427E+09	8.3200E+12	1.7985E-13	7.0083E-20	7.6836E+17	1.1150E+15
2200	2.5345E+16	2.6666E+18	3.6937E+10	2.6796E+13	2.1883E-10	6.8228E-16	6.9051E+17	4.0736E+15
2400	2.3310E+16	2.4474E+18	3.0279E+11	7.1191E+13	8.1952E-08	1.4440E-12	6.2233E+17	1.1876E+16
2600	2.1515E+16	2.2583E+18	1.7866E+12	1.6272E+14	1.2395E-05	9.4520E-10	5.5704E+17	2.8975E+16
2800	1.9134E+16	2.0162E+18	7.9916E+12	3.2377E+14	9.0381E-04	2.4638E-07	4.7225E+17	5.9977E+16
3000	1.7359E+16	1.8500E+18	2.9427E+13	5.9079E+14	3.7851E-02	3.0807E-05	3.9794E+17	1.1091E+17
3200	1.5539E+16	1.6956E+18	9.1439E+13	9.8957E+14	1.0017E+00	2.1274E-03	3.1820E+17	1.8274E+17
3400	1.3628E+16	1.5508E+18	2.4694E+14	1.5368E+15	1.8232E+01	9.0479E-02	2.3613E+17	2.6953E+17
3600	1.1696E+16	1.4218E+18	5.9456E+14	2.2332E+15	2.4468E+02	2.5828E+00	1.6028E+17	3.5768E+17
3800	9.7616E+15	1.3109E+18	1.3021E+15	3.0552E+15	2.5606E+03	5.3022E+01	9.9127E+16	4.3035E+17
4000	7.9311E+15	1.2194E+18	2.6366E+15	3.9573E+15	2.1844E+04	8.2671E+02	5.6879E+16	4.7744E+17
4200	6.2487E+15	1.1439E+18	4.9940E+15	4.8708E+15	1.5716E+05	1.0228E+04	3.1310E+16	4.9975E+17
4400	4.7597E+15	1.0796E+18	8.9246E+15	5.7126E+15	9.7867E+05	1.0399E+05	1.7083E+16	5.0426E+17
4600	3.5170E+15	1.0222E+18	1.5148E+16	6.3945E+15	5.3880E+06	8.9451E+05	9.4480E+15	4.9811E+17
4800	2.5354E+15	9.6847E+17	2.4551E+16	6.8764E+15	2.6550E+07	6.6348E+06	5.3567E+15	4.8615E+17
5000	1.8007E+15	9.1609E+17	3.8171E+16	7.1511E+15	1.1817E+08	4.3067E+07	3.1245E+15	4.7102E+17
5200	1.2740E+15	8.6315E+17	5.7135E+16	7.2441E+15	4.7780E+08	2.4727E+08	1.8744E+15	4.5410E+17
5400	9.0616E+14	8.0805E+17	8.2564E+16	7.1930E+15	1.7624E+09	1.2668E+09	1.1535E+15	4.3597E+17
5600	6.5181E+14	7.4953E+17	1.1543E+17	7.0347E+15	5.9504E+09	5.8357E+09	7.2544E+14	4.1686E+17
5800	4.9497E+14	6.8674E+17	1.5635E+17	6.7792E+15	1.8503E+10	2.4414E+10	4.6465E+14	3.9686E+17
6000	3.6904E+14	6.1929E+17	2.0534E+17	6.4892E+15	5.2810E+10	9.2792E+10	3.0195E+14	3.7601E+17
6200	2.9504E+14	5.4768E+17	2.6161E+17	6.1441E+15	1.3942E+11	3.2426E+11	1.9856E+14	3.5449E+17
6400	2.2666E+14	4.7315E+17	3.2334E+17	5.7929E+15	3.3901E+11	1.0403E+12	1.3187E+14	3.3257E+17
6600	1.8868E+14	3.9794E+17	3.8769E+17	5.4186E+15	7.6342E+11	3.0914E+12	8.8429E+13	3.1074E+17
6800	1.4847E+14	3.2488E+17	4.5097E+17	5.0630E+15	1.5844E+12	8.4909E+12	5.9950E+13	2.8958E+17
7000	1.2804E+14	2.5712E+17	5.0929E+17	4.7151E+15	3.0463E+12	2.1702E+13	4.1211E+13	2.6973E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	6.7991E-06	1.3081E-12	2.9896E+16	1.4582E+00	8.3200E+12	3.7614E+18	8.3200E+12	7.582E-03
2200	1.3674E-03	2.2447E-09	4.4324E+16	1.0100E+02	2.6796E+13	3.4309E+18	2.6796E+13	7.605E-03
2400	1.1281E-01	1.1123E-06	6.0878E+16	3.4437E+03	7.1191E+13	3.1659E+18	7.1191E+13	7.645E-03
2600	4.6531E+00	2.1137E-04	7.8385E+16	6.7781E+04	1.6272E+14	2.9445E+18	1.6272E+14	7.679E-03
2800	1.0813E+02	1.8826E-02	9.1885E+16	8.4649E+05	3.2377E+14	2.6601E+18	3.2377E+14	7.422E-03
3000	1.6074E+03	9.0881E-01	1.0457E+17	7.4992E+06	5.9079E+14	2.4820E+18	5.9079E+14	7.336E-03
3200	1.6088E+04	2.6438E+01	1.1213E+17	4.9240E+07	9.8957E+14	2.3263E+18	9.8957E+14	7.206E-03
3400	1.1429E+05	5.0125E+02	1.1263E+17	2.4972E+08	1.5368E+15	2.1860E+18	1.5368E+15	7.024E-03
3600	5.7934E+05	6.5833E+03	1.0592E+17	1.0127E+09	2.2332E+15	2.0624E+18	2.2332E+15	6.827E-03
3800	2.2384E+06	6.3166E+04	9.3557E+16	3.3921E+09	3.0552E+15	1.9511E+18	3.0552E+15	6.635E-03
4000	6.8588E+06	4.6656E+05	7.8673E+16	9.7268E+09	3.9573E+15	1.8508E+18	3.9573E+15	6.479E-03
4200	1.7694E+07	2.7966E+06	6.4175E+16	2.4803E+10	4.8708E+15	1.7601E+18	4.8708E+15	6.363E-03
4400	4.0585E+07	1.4245E+07	5.1654E+16	5.8125E+10	5.7126E+15	1.6777E+18	5.7126E+15	6.278E-03
4600	8.6241E+07	6.3942E+07	4.1494E+16	1.2837E+11	6.3946E+15	1.6027E+18	6.3946E+15	6.211E-03
4800	1.7350E+08	2.5844E+08	3.3452E+16	2.7042E+11	6.8766E+15	1.5343E+18	6.8766E+15	6.155E-03
5000	3.3419E+08	9.5378E+08	2.7118E+16	5.4655E+11	7.1517E+15	1.4716E+18	7.1517E+15	6.098E-03
5200	6.1918E+08	3.2416E+09	2.2093E+16	1.0615E+12	7.2451E+15	1.4141E+18	7.2451E+15	6.034E-03
5400	1.1047E+09	1.0206E+10	1.8058E+16	1.9807E+12	7.1950E+15	1.3611E+18	7.1950E+15	5.958E-03
5600	1.8993E+09	2.9918E+10	1.4771E+16	3.5482E+12	7.0382E+15	1.3120E+18	7.0383E+15	5.864E-03
5800	3.1572E+09	8.2290E+10	1.2058E+16	6.1177E+12	6.7854E+15	1.2665E+18	6.7855E+15	5.748E-03
6000	5.0483E+09	2.1211E+11	9.7924E+15	1.0089E+13	6.4993E+15	1.2241E+18	6.4997E+15	5.606E-03
6200	7.8204E+09	5.1769E+11	7.8908E+15	1.6008E+13	6.1601E+15	1.1845E+18	6.1611E+15	5.439E-03
6400	1.1694E+10	1.1949E+12	6.2929E+15	2.4299E+13	5.8172E+15	1.1474E+18	5.8198E+15	5.249E-03
6600	1.7010E+10	2.6328E+12	4.9596E+15	3.5479E+13	5.4541E+15	1.1125E+18	5.4606E+15	5.042E-03
6800	2.4025E+10	5.5304E+12	3.8608E+15	4.9605E+13	5.1126E+15	1.0797E+18	5.1282E+15	4.828E-03
7000	3.3230E+10	1.1165E+13	2.9718E+15	6.6792E+13	4.7819E+15	1.0489E+18	4.8179E+15	4.619E-03

PARTICLE NUMBER DENSITIES
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917   B = 5.000E-02

T(K)	N1	N2	N3	N4	N5	N6	N7	N8
2000	1.489[illegible]E+17	3.0463E+18	2.9984E+09	1.9249E+13	8.0706E-14	3.0865E-20	7.9778E+17	1.1362E+15
2200	1.3663E+17	2.7571E+18	3.7559E+10	6.2215E+13	9.7450E-11	2.9881E-16	7.1399E+17	4.1423E+15
2400	1.2572E+17	2.5289E+18	3.0779E+11	1.6533E+14	3.6463E-08	6.3203E-13	6.4310E+17	1.2073E+16
2600	1.1634E+17	2.3334E+18	1.8160E+12	3.7841E+14	5.5073E-06	4.1316E-10	5.7586E+17	2.9461E+16
2800	1.0780E+17	2.1589E+18	8.2697E+12	7.6858E+14	4.0769E-04	1.0740E-07	5.0668E+17	6.2125E+16
3000	9.5071E+16	1.9079E+18	2.9884E+13	1.3828E+15	1.6677E-02	1.3366E-05	4.1117E+17	1.1273E+17
3200	8.6396E+16	1.7468E+18	9.2810E+13	2.3342E+15	4.3749E-01	9.1542E-04	3.2896E+17	1.8580E+17
3400	7.7579E+16	1.5944E+18	2.5039E+14	3.6689E+15	7.8516E+00	3.8428E-02	2.4417E+17	2.7408E+17
3600	6.8949E+16	1.4581E+18	6.0209E+14	5.4301E+15	1.0320E+02	1.0757E+00	1.6575E+17	3.6372E+17
3800	6.0646E+16	1.3401E+18	1.3166E+15	7.6326E+15	1.0478E+03	2.1459E+01	1.0240E+17	4.3740E+17
4000	5.2816E+16	1.2412E+18	2.6601E+15	1.0253E+16	8.5823E+03	3.2193E+02	5.8548E+16	4.8439E+17
4200	4.5474E+16	1.1587E+18	5.0263E+15	1.3226E+16	5.8629E+04	3.7912E+03	3.2024E+16	5.0541E+17
4400	3.8583E+16	1.0878E+18	8.9583E+15	1.6401E+16	3.4345E+05	3.6357E+04	1.7319E+16	5.0772E+17
4600	3.2092E+16	1.0236E+18	1.5158E+16	1.9627E+16	1.7578E+06	2.9164E+05	9.4715E+15	4.9873E+17
4800	2.6158E+16	9.6340E+17	2.4487E+16	2.2626E+16	8.0272E+06	2.0112E+06	5.3034E+15	4.8372E+17
5000	2.0879E+16	9.0519E+17	3.7943E+16	2.5211E+16	3.3123E+07	1.2144E+07	3.0537E+15	4.6565E+17
5200	1.6236E+16	8.4717E+17	5.6604E+16	2.7335E+16	1.2430E+08	6.4930E+07	1.8085E+15	4.4604E+17
5400	1.2470E+16	7.8838E+17	8.1553E+16	2.8724E+16	4.3069E+08	3.1343E+08	1.1005E+15	4.2585E+17
5600	9.4584E+15	7.2750E+17	1.1372E+17	2.9451E+16	1.3802E+09	1.3739E+09	6.8557E+14	4.0524E+17
5800	7.2807E+15	6.6385E+17	1.5372E+17	2.9418E+16	4.1254E+09	5.5365E+09	4.3613E+14	3.8449E+17
6000	5.4929E+15	5.9645E+17	2.0152E+17	2.9012E+16	1.1393E+10	2.0399E+10	2.8186E+14	3.6328E+17
6200	4.1409E+15	5.2582E+17	2.5634E+17	2.8194E+16	2.9243E+10	6.9410E+10	1.8464E+14	3.4184E+17
6400	3.1263E+15	4.5305E+17	3.1640E+17	2.7071E+16	6.9742E+10	2.1870E+11	1.2237E+14	3.2037E+17
6600	2.5083E+15	3.8031E+17	3.7900E+17	2.5620E+16	1.5528E+11	6.4318E+11	8.2052E+13	2.9933E+17
6800	1.9296E+15	3.0983E+17	4.4040E+17	2.4217E+16	3.1886E+11	1.7498E+12	5.5647E+13	2.7899E+17
7000	1.4995E+15	2.4472E+17	4.9685E+17	2.2814E+16	6.0737E+11	4.4351E+12	3.8300E+13	2.6003E+17

T(K)	N9	N10	N11	N12	NE	NT	NI	A
2000	3.0513E-06	5.7612E-13	3.1040E+16	6.5941E-01	1.9249E+13	4.0251E+18	1.9249E+13	4.102E-02
2200	6.0896E-04	9.8308E-10	4.5830E+16	4.4981E+01	6.2215E+13	3.6578E+18	6.2215E+13	4.097E-02
2400	5.0196E-02	4.8690E-07	6.2907E+16	1.5323E+03	1.6533E+14	3.3730E+18	1.6533E+14	4.116E-02
2600	2.0686E+00	9.2416E-05	8.1014E+16	3.0125E+04	3.7841E+14	3.1369E+18	3.7841E+14	4.134E-02
2800	4.8873E+01	8.2146E-03	9.8487E+16	3.8222E+05	7.6858E+14	2.9356E+18	7.6858E+14	4.142E-02
3000	7.0958E+02	3.9468E-01	1.0795E+17	3.3073E+06	1.3828E+15	2.6376E+18	1.3828E+15	3.942E-02
3200	7.0510E+03	1.1396E+01	1.1572E+17	2.1543E+07	2.3342E+15	2.4684E+18	2.3342E+15	3.868E-02
3400	4.9504E+04	2.1350E+02	1.1613E+17	1.0785E+08	3.6689E+15	2.3140E+18	3.6689E+15	3.763E-02
3600	2.4639E+05	2.7533E+03	1.0908E+17	4.2891E+08	5.4301E+15	2.1770E+18	5.4301E+15	3.648E-02
3800	9.2560E+05	2.5699E+04	9.6141E+16	1.3953E+09	7.6326E+15	2.0533E+18	7.6326E+15	3.535E-02
4000	2.7249E+06	1.8270E+05	8.0531E+16	3.8429E+09	1.0253E+16	1.9407E+18	1.0253E+16	3.437E-02
4200	6.6649E+06	1.0416E+06	6.5321E+16	9.2975E+09	1.3226E+16	1.8385E+18	1.3226E+16	3.359E-02
4400	1.4331E+07	4.9956E+06	5.2205E+16	2.0461E+10	1.6401E+16	1.7454E+18	1.6401E+16	3.296E-02
4600	2.8168E+07	2.0859E+07	4.1573E+16	4.1905E+10	1.9627E+16	1.6599E+18	1.9627E+16	3.241E-02
4800	5.2207E+07	7.8157E+07	3.3198E+16	8.1564E+10	2.2626E+16	1.5815E+18	2.2626E+16	3.190E-02
5000	9.2650E+07	2.6747E+08	2.6649E+16	1.5236E+11	2.5212E+16	1.5098E+18	2.5212E+16	3.140E-02
5200	1.5834E+08	8.4392E+08	2.1499E+16	2.7379E+11	2.7335E+16	1.4440E+18	2.7335E+16	3.087E-02
5400	2.6401E+08	2.4970E+09	1.7422E+16	4.7868E+11	2.8724E+16	1.3842E+18	2.8724E+16	3.031E-02
5600	4.2894E+08	6.9504E+09	1.4147E+16	8.1208E+11	2.9452E+16	1.3297E+18	2.9452E+16	2.969E-02
5800	6.8349E+08	1.8388E+10	1.1486E+16	1.3441E+12	2.9419E+16	1.2801E+18	2.9419E+16	2.900E-02
6000	1.0556E+09	4.5906E+10	9.2849E+15	2.1429E+12	2.9015E+16	1.2343E+18	2.9015E+16	2.821E-02
6200	1.5887E+09	1.0906E+11	7.4559E+15	3.3043E+12	2.8198E+16	1.1922E+18	2.8198E+16	2.731E-02
6400	2.3314E+09	2.4731E+11	5.9318E+15	4.9211E+12	2.7076E+16	1.1531E+18	2.7076E+16	2.633E-02
6600	3.3591E+09	5.3974E+11	4.6704E+15	7.1106E+12	2.5627E+16	1.1172E+18	2.5629E+16	2.529E-02
6800	4.7059E+09	1.1244E+12	3.6325E+15	9.8487E+12	2.4227E+16	1.0833E+18	2.4230E+16	2.422E-02
7000	6.4693E+09	2.2547E+12	2.7950E+15	1.3159E+13	2.2827E+16	1.0516E+18	2.2835E+16	2.319E-02

Table AVII. Absolute emission coefficients as a function of temperature for atomic lines of potassium and nitrogen ($watt\text{-}cm^{-3}\text{-}sr^{-1}$), the electron continuum ($watt\text{-}cm^{-3}\text{-}sr^{-1}sec$), and the P-branch increment of the molecular ion band head ($watt\text{-}cm^{-3}\text{-}sr^{-1}$) computed for one atm air plasmas seeded with potassium at seven different mass ratios.

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917 B = 0.

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	0.	0.	0.	3.9839E-38	5.8717E-34	1.4428E-34	4.8743E-28
2200	0.	0.	0.	5.2806E-34	4.1196E-30	3.0584E-32	6.0802E-25
2400	0.	0.	0.	1.4297E-30	6.5639E-27	2.6346E-30	2.2882E-22
2600	0.	0.	0.	1.1403E-27	3.3430E-24	1.1300E-28	3.4315E-20
2800	0.	0.	0.	3.4796E-25	6.9445E-22	2.7813E-27	2.5040E-18
3000	0.	0.	0.	4.9187E-23	7.0347E-20	4.3440E-26	1.0307E-16
3200	0.	0.	0.	3.7186E-21	3.9732E-18	4.6260E-25	2.6792E-15
3400	0.	0.	0.	1.6794E-19	1.3874E-16	3.5396E-24	4.8075E-14
3600	0.	0.	0.	4.9438E-18	3.2491E-15	2.0294E-23	6.3932E-13
3800	0.	0.	0.	1.0172E-16	5.4483E-14	9.0669E-23	6.6582E-12
4000	0.	0.	0.	1.5466E-15	6.8902E-13	3.2902E-22	5.6427E-11
4200	0.	0.	0.	1.8150E-14	6.8450E-12	1.0105E-21	3.9884E-10
4400	0.	0.	0.	1.7022E-13	5.5172E-11	2.7209E-21	2.3922E-09
4600	0.	0.	0.	1.3121E-12	3.7037E-10	6.5949E-21	1.2354E-08
4800	0.	0.	0.	8.5102E-12	2.1161E-09	1.4652E-20	5.5699E-08
5000	0.	0.	0.	4.7361E-11	1.0480E-08	3.0202E-20	2.2215E-07
5200	0.	0.	0.	2.2990E-10	4.5680E-08	5.8252E-20	7.9287E-07
5400	0.	0.	0.	9.8689E-10	1.7749E-07	1.0571E-19	2.5582E-06
5600	0.	0.	0.	3.7895E-09	6.2126E-07	1.8111E-19	7.5250E-06
5800	0.	0.	0.	1.3140E-08	1.9764E-06	2.9337E-19	2.0320E-05
6000	0.	0.	0.	4.1472E-08	5.7555E-06	4.4912E-19	5.0649E-05
6200	0.	0.	0.	1.1991E-07	1.5435E-05	6.4825E-19	1.1703E-04
6400	0.	0.	0.	3.1936E-07	3.8308E-05	8.7772E-19	2.5143E-04
6600	0.	0.	0.	7.8707E-07	8.8358E-05	1.1063E-18	5.0341E-04
6800	0.	0.	0.	1.8027E-06	1.9014E-04	1.2854E-18	9.4103E-04
7000	0.	0.	0.	3.8537E-06	3.8326E-04	1.3642E-18	1.6456E-03

EMISSION COEFFICIENTS

- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -

TOTAL PRESSURE = 1.0000 ATM

NIT/OXY = 3.2917 B = 1.000E-04

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	4.8378E-10	2.9089E-09	9.7745E-08	4.0001E-38	5.8956E-34	8.1940E-24	2.0620E-33
2200	3.8385E-09	1.8977E-08	5.3323E-07	5.3155E-34	4.1468E-30	8.0619E-23	1.2000E-29
2400	2.0711E-08	8.6985E-08	2.1057E-06	1.4297E-30	6.5641E-27	5.2438E-22	1.6220E-26
2600	6.3914E-08	3.0699E-07	6.5511E-06	1.1402E-27	3.3428E-24	2.5045E-21	7.2881E-24
2800	2.6146E-07	8.4982E-07	1.6277E-05	3.4794E-25	6.9442E-22	9.0354E-21	1.3893E-21
3000	6.3377E-07	1.8592E-06	3.2424E-05	4.9187E-23	7.0347E-20	2.4986E-20	1.3592E-19
3200	1.1881E-06	3.1861E-06	5.1193E-05	3.7186E-21	3.9732E-18	5.2781E-20	7.9328E-18
3400	1.7146E-06	4.2482E-06	6.3496E-05	1.6794E-19	1.3873E-16	8.4956E-20	3.1036E-16
3600	1.9413E-06	4.4832E-06	6.2836E-05	4.9435E-18	3.2490E-15	1.0635E-19	8.8332E-15
3800	1.8455E-06	4.0019E-06	5.2954E-05	1.0172E-16	5.4480E-14	1.1098E-19	1.9036E-13
4000	1.5994E-06	3.2772E-06	4.1177E-05	1.5465E-15	6.8898E-13	1.0506E-19	3.1586E-12
4200	1.3449E-06	2.6180E-06	3.1389E-05	1.8149E-14	6.8446E-12	9.6427E-20	4.0841E-11
4400	1.1359E-06	2.1104E-06	2.4248E-05	1.7021E-13	5.5169E-11	8.9587E-20	4.1705E-10
4600	9.8912E-07	1.7612E-06	1.9464E-05	1.3121E-12	3.7035E-10	8.7762E-20	3.3881E-09
4800	9.0388E-07	1.5478E-06	1.6507E-05	8.5098E-12	2.1160E-09	9.3919E-20	2.2013E-08
5000	8.7584E-07	1.4469E-06	1.4933E-05	4.7359E-11	1.0480E-08	1.1199E-19	1.1547E-07
5200	8.9146E-07	1.4248E-06	1.4266E-05	2.2989E-10	4.5678E-08	1.4660E-19	5.0040E-07
5400	9.3823E-07	1.4542E-06	1.4159E-05	9.8685E-10	1.7748E-07	2.0409E-19	1.8442E-06
5600	1.0028E-06	1.5106E-06	1.4330E-05	3.7893E-09	6.2123E-07	2.9206E-19	5.9387E-06
5800	1.0735E-06	1.5748E-06	1.4581E-05	1.3140E-08	1.9763E-06	4.1836E-19	1.7066E-05
6000	1.1399E-06	1.6314E-06	1.4768E-05	4.1470E-08	5.7553E-06	5.8844E-19	4.4422E-05
6200	1.1948E-06	1.6708E-06	1.4808E-05	1.1991E-07	1.5435E-05	8.0100E-19	1.0583E-04
6400	1.2302E-06	1.6834E-06	1.4626E-05	3.1935E-07	3.8307E-05	1.0414E-18	2.3243E-04
6600	1.2436E-06	1.6674E-06	1.4220E-05	7.8793E-07	8.8354E-05	1.2767E-18	4.7286E-04
6800	1.2353E-06	1.6247E-06	1.3615E-05	1.8026E-06	1.9013E-04	1.4562E-18	8.9438E-04
7000	1.2088E-06	1.5614E-06	1.2870E-05	3.8536E-06	3.8324E-04	1.5268E-18	1.5777E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917   B = 5.0000E-04

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	2.4249E-09	1.4581E-08	4.8994E-07	4.0008E-38	5.8967E-34	4.1072E-23	9.2136E-34
2200	1.9319E-08	9.5511E-08	2.6837E-06	5.3163E-34	4.1474E-30	4.0575E-22	5.3504E-30
2400	1.0753E-07	4.5162E-07	1.0933E-05	1.4440E-30	6.6297E-27	2.7225E-21	7.2614E-27
2600	4.3830E-07	1.6035E-06	3.4218E-05	1.1405E-27	3.3435E-24	1.3082E-20	3.1903E-24
2800	1.4373E-06	4.6714E-06	8.9473E-05	3.4799E-25	6.9452E-22	4.9667E-20	5.9271E-22
3000	3.8205E-06	1.1207E-05	1.9546E-04	4.9192E-23	7.0354E-20	1.5062E-19	5.5371E-20
3200	8.3379E-06	2.2360E-05	3.5928E-04	3.7188E-21	3.9734E-18	3.7042E-19	2.9949E-18
3400	1.4977E-05	3.7107E-05	5.5463E-04	1.6794E-19	1.3873E-16	7.4205E-19	1.0502E-16
3600	2.2169E-05	5.1197E-05	7.1756E-04	4.9432E-18	3.2488E-15	1.2142E-18	2.6138E-15
3800	2.734 E-05	5.9285E-05	7.8448E-04	1.0171E-16	5.4474E-14	1.6428E-18	4.9464E-14
4000	2.8951E-05	5.9319E-05	7.4532E-04	1.5462E-15	6.8886E-13	1.8960E-18	7.4326E-13
4200	2.7594E-05	5.3706E-05	6.4392E-04	1.8145E-14	6.8432E-12	1.9584E-18	9.0588E-12
4400	2.4738E-05	4.5961E-05	5.2808E-04	1.7017E-13	5.5157E-11	1.8945E-18	9.0651E-11
4600	2.1484E-05	3.8254E-05	4.2277E-04	1.3118E-12	3.7027E-10	1.7696E-18	7.5421E-10
4800	1.8451E-05	3.1596E-05	3.3696E-04	8.5079E-12	2.1155E-09	1.6328E-18	5.2778E-09
5000	1.5865E-05	2.6217E-05	2.7058E-04	4.7348E-11	1.0477E-08	1.5121E-18	3.1419E-08
5200	1.3728E-05	2.1940E-05	2.1969E-04	2.2984E-10	4.5667E-08	1.4187E-18	1.6090E-07
5400	1.2046E-05	1.8671E-05	1.8179E-04	9.8664E-10	1.7744E-07	1.3689E-18	7.1289E-07
5600	1.0794E-05	1.6263E-05	1.5427E-04	3.7885E-09	6.2110E-07	1.3757E-18	2.7433E-06
5800	9.8868E-06	1.4504E-05	1.3430E-04	1.3137E-08	1.9759E-06	1.4449E-18	9.2268E-06
6000	9.2324E-06	1.3213E-05	1.1961E-04	4.1462E-08	5.7542E-06	1.5781E-18	2.7343E-05
6200	8.7458E-06	1.2230E-05	1.0839E-04	1.1988E-07	1.5432E-05	1.7680E-18	7.2133E-05
6400	8.3273E-06	1.1395E-05	9.9006E-05	3.1928E-07	3.8299E-05	1.9894E-18	1.7137E-04
6600	7.9470E-06	1.0646E-05	9.0789E-05	7.8688E-07	8.8337E-05	2.2027E-18	3.6992E-04
6800	7.5394E-06	9.9164E-06	8.3099E-05	1.8023E-06	1.9009E-04	2.3441E-18	7.3179E-04
7000	7.1373E-06	9.2191E-06	7.5990E-05	3.8528E-06	3.8317E-04	2.3501E-18	1.3350E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917   B = 1.000E-03

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	4.8561E-09	2.9200E-08	9.8115E-07	4.0016E-38	5.8978E-34	8.2250E-23	6.5131E-34
2200	3.8725E-08	1.9145E-07	5.3796E-06	5.3172E-34	4.1481E-30	8.1333E-22	3.7804E-30
2400	2.1612E-07	9.0769E-07	2.1973E-05	1.4443E-30	6.6309E-27	5.4719E-21	5.1239E-27
2600	8.8648E-07	3.2431E-06	6.9207E-05	1.1407E-27	3.3441E-24	2.6459E-20	2.2442E-24
2800	2.9422E-06	9.5628E-06	1.8316E-04	3.4806E-25	6.9466E-22	1.0167E-19	4.1443E-22
3000	7.9959E-06	2.3456E-05	4.0908E-04	4.9199E-23	7.0363E-20	3.1523E-19	3.8285E-20
3200	1.8112E-05	4.8573E-05	7.8046E-04	3.7193E-21	3.9740E-18	8.0466E-19	2.0325E-18
3400	3.4470E-05	8.5405E-05	1.2765E-03	1.6795E-19	1.3874E-16	1.7079E-18	6.9232E-17
3600	5.5344E-05	1.2781E-04	1.7913E-03	4.9434E-18	3.2489E-15	3.0312E-18	1.6544E-15
3800	7.5421E-05	1.6354E-04	2.1641E-03	1.0170E-16	5.4471E-14	4.5317E-18	2.9779E-14
4000	8.8682E-05	1.8171E-04	2.2831E-03	1.5460E-15	6.8877E-13	5.8072E-18	4.2458E-13
4200	9.2298E-05	1.7967E-04	2.1541E-03	1.8142E-14	6.8419E-12	6.5492E-18	4.9518E-12
4400	8.8168E-05	1.6381E-04	1.8822E-03	1.7013E-13	5.5145E-11	6.7453E-18	4.8020E-11
4600	7.9836E-05	1.4215E-04	1.5710E-03	1.3114E-12	3.7017E-10	6.5580E-18	3.9158E-10
4800	7.0027E-05	1.1992E-04	1.2789E-03	8.5056E-12	2.1149E-09	6.1559E-18	2.7167E-09
5000	6.0677E-05	1.0024E-04	1.0346E-03	4.7335E-11	1.0474E-08	5.6963E-18	1.6179E-08
5200	5.2141E-05	8.3333E-05	8.3441E-04	2.2977E-10	4.5654E-08	5.2256E-18	8.3797E-08
5400	4.4775E-05	6.9399E-05	6.7569E-04	9.8635E-10	1.7739E-07	4.8011E-18	3.8053E-07
5600	3.8650E-05	5.8223E-05	5.5232E-04	3.7874E-09	6.2092E-07	4.4580E-18	1.5239E-06
5800	3.3512E-05	4.9162E-05	4.5520E-04	1.3133E-08	1.9753E-06	4.1968E-18	5.4184E-06
6000	2.9386E-05	4.2056E-05	3.8070E-04	4.1451E-08	5.7526E-06	4.0435E-18	1.7126E-05
6200	2.5996E-05	3.6353E-05	3.2218E-04	1.1985E-07	1.5427E-05	3.9791E-18	4.8360E-05
6400	2.3270E-05	3.1942E-05	2.7666E-04	3.1920E-07	3.8289E-05	3.9911E-18	1.2234E-04
6600	2.1002E-05	2.8158E-05	2.4014E-04	7.8668E-07	8.8314E-05	4.0230E-18	2.7902E-04
6800	1.9070E-05	2.5082E-05	2.1019E-04	1.8018E-06	1.9004E-04	3.9988E-18	5.7758E-04
7000	1.7400E-05	2.2475E-05	1.8525E-04	3.8518E-06	3.8307E-04	3.8316E-18	1.0929E-03

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917 B = 5.000E-03

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	2.4455E-08	1.4705E-07	4.9410E-06	4.0080E-38	5.9073E-34	4.1420E-22	2.9117E-34
2200	1.9535E-07	9.6581E-07	2.7138E-05	5.3251E-34	4.1543E-30	4.1029E-21	1.6882E-30
2400	1.0941E-06	4.5952E-06	1.1124E-04	1.4464E-30	6.6409E-27	2.7702E-20	2.2841E-27
2600	4.6500E-06	1.7012E-05	3.6302E-04	1.1581E-27	3.3951E-24	1.3879E-19	1.0100E-24
2800	1.5262E-05	4.9605E-05	9.5008E-04	3.4855E-25	6.9564E-22	5.2740E-19	1.8248E-22
3000	4.2728E-05	1.2534E-04	2.1860E-03	4.9264E-23	7.0457E-20	1.6845E-18	1.6606E-20
3200	1.0175E-04	2.7287E-04	4.3843E-03	3.7238E-21	3.9788E-18	4.5203E-18	8.5962E-19
3400	2.0964E-04	5.1942E-04	7.7636E-03	1.6814E-19	1.3890E-16	1.0387E-17	2.8136E-17
3600	3.7808E-04	8.7311E-04	1.2237E-02	4.9467E-18	3.2511E-15	2.0708E-17	6.3384E-16
3800	6.0360E-04	1.3089E-03	1.7319E-02	1.0173E-16	5.4488E-14	3.6267E-17	1.0533E-14
4000	8.5905E-04	1.7602E-03	2.2116E-02	1.5458E-15	6.8867E-13	5.6251E-17	1.3638E-13
4200	1.0987E-03	2.1387E-03	2.5642E-02	1.8131E-14	6.8378E-12	7.7948E-17	1.4336E-12
4400	1.2694E-03	2.3585E-03	2.7099E-02	1.6995E-13	5.5087E-11	9.7082E-17	1.2631E-11
4600	1.3448E-03	2.3944E-03	2.6462E-02	1.3096E-12	3.6965E-10	1.1036E-16	9.5186E-11
4800	1.3291E-03	2.2760E-03	2.4274E-02	8.4910E-12	2.1113E-09	1.1658E-16	6.2214E-10
5000	1.2482E-03	2.0621E-03	2.1282E-02	4.7244E-11	1.0454E-08	1.1659E-16	3.5624E-09
5200	1.1312E-03	1.8079E-03	1.8102E-02	2.2929E-10	4.5560E-08	1.1216E-16	1.8013E-08
5400	9.9611E-04	1.5439E-03	1.5032E-02	9.8421E-10	1.7700E-07	1.0457E-16	8.1190E-08
5600	8.6613E-04	1.3048E-03	1.2377E-02	3.7789E-09	6.1953E-07	9.6031E-17	3.2695E-07
5800	7.4020E-04	1.0859E-03	1.0054E-02	1.3103E-08	1.9708E-06	8.6520E-17	1.1888E-06
6000	6.2859E-04	8.9960E-04	8.1433E-03	4.1354E-08	5.7392E-06	7.7353E-17	3.9050E-06
6200	5.2704E-04	7.3701E-04	6.5319E-03	1.1957E-07	1.5391E-05	6.8226E-17	1.1682E-05
6400	4.4050E-04	6.0277E-04	5.2372E-03	3.1845E-07	3.8199E-05	5.9951E-17	3.1780E-05
6600	3.6527E-04	4.8973E-04	4.1765E-03	7.8481E-07	8.8105E-05	5.2226E-17	7.9024E-05
6800	3.0370E-04	3.9945E-04	3.3474E-03	1.7975E-06	1.8959E-04	4.5503E-17	1.7916E-04
7000	2.5277E-04	3.2650E-04	2.6912E-03	3.8426E-06	3.8215E-04	3.9414E-17	3.7199E-04

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917   B = 1.000E-02

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	4.9440E-08	2.9728E-07	9.9891E-06	4.0182E-38	5.9223E-34	8.3739E-22	2.0583E-34
2200	3.9433E-07	1.9495E-06	5.4779E-05	5.3350E-34	4.1620E-30	8.2820E-21	1.1926E-30
2400	2.2106E-06	9.2842E-06	2.2475E-04	1.4492E-30	6.6536E-27	5.5969E-20	1.6131E-27
2600	9.4129E-06	3.4436E-05	7.3485E-04	1.1603E-27	3.4016E-24	2.8094E-19	7.1256E-25
2800	3.1014E-05	1.0080E-04	1.9307E-03	3.4921E-25	6.9695E-22	1.0717E-18	1.2849E-22
3000	8.7448E-05	2.5653E-04	4.4739E-03	4.9357E-23	7.0589E-20	3.4475E-18	1.1651E-20
3200	2.1080E-04	5.6533E-04	9.0835E-03	3.7310E-21	3.9864E-18	9.3652E-18	5.9951E-19
3400	4.4225E-04	1.0957E-03	1.6378E-02	1.6836E-19	1.3908E-16	2.1912E-17	1.9423E-17
3600	8.2105E-04	1.8961E-03	2.6575E-02	4.9529E-18	3.2551E-15	4.4969E-17	4.3119E-16
3800	1.3634E-03	2.9564E-03	3.9121E-02	1.0182E-16	5.4535E-14	8.1920E-17	7.0205E-15
4000	2.0458E-03	4.1918E-03	5.2669E-02	1.5465E-15	6.8901E-13	1.3396E-16	8.8463E-14
4200	2.7915E-03	5.4339E-03	6.5152E-02	1.8132E-14	6.8382E-12	1.9805E-16	8.9948E-13
4400	3.4803E-03	6.4662E-03	7.4296E-02	1.6988E-13	5.5062E-11	2.6616E-16	7.6215E-12
4600	3.9747E-03	7.0770E-03	7.8213E-02	1.3083E-12	3.6929E-10	3.2617E-16	5.5260E-11
4800	4.2103E-03	7.2099E-03	7.6892E-02	8.4788E-12	2.1083E-09	3.6926E-16	3.4857E-10
5000	4.1902E-03	6.9224E-03	7.1445E-02	4.7157E-11	1.0435E-08	3.9132E-16	1.9374E-09
5200	3.9730E-03	6.3498E-03	6.3581E-02	2.2880E-10	4.5462E-08	3.9381E-16	9.5718E-09
5400	3.6332E-03	5.6313E-03	5.4828E-02	9.8185E-10	1.7658E-07	3.8112E-16	4.2324E-08
5600	3.2344E-03	4.8724E-03	4.6221E-02	3.7692E-09	6.1793E-07	3.5812E-16	1.6844E-07
5800	2.8050E-03	4.1150E-03	3.8101E-02	1.3068E-08	1.9655E-06	3.2706E-16	6.0814E-07
6000	2.4075E-03	3.4455E-03	3.1189E-02	4.1238E-08	5.7231E-06	2.9501E-16	1.9886E-06
6200	2.0279E-03	2.8358E-03	2.5132E-02	1.1923E-07	1.5347E-05	2.6068E-16	5.9432E-06
6400	1.6989E-03	2.3247E-03	2.0198E-02	3.1750E-07	3.8086E-05	2.2874E-16	1.6184E-05
6600	1.4050E-03	1.8838E-03	1.6066E-02	7.8244E-07	8.7839E-05	1.9786E-16	4.0422E-05
6800	1.1630E-03	1.5296E-03	1.2818E-02	1.7920E-06	1.8901E-04	1.7096E-16	9.2245E-05
7000	9.5924E-04	1.2390E-03	1.0213E-02	3.8306E-06	3.8095E-04	1.4676E-16	1.9346E-04

EMISSION COEFFICIENTS
- POTASSIUM SEEDED NITROGEN/OXYGEN MIXTURE -
TOTAL PRESSURE = 1.0000 ATM
NIT/OXY = 3.2917 B = 5.000E-02

T(K)	E4965KI	E5832KI	E6936KI	E4935NI	E7469NI	E5600C	E3914N2+
2000	2.6463E-07	1.5912E-06	5.3467E-05	4.0943E-38	6.0344E-34	4.4821E-21	9.2365E-35
2200	2.1257E-06	1.0509E-05	2.9530E-04	5.4248E-34	4.2321E-30	4.4646E-20	5.3111E-31
2400	1.1923E-05	5.0074E-05	1.2122E-03	1.4731E-30	6.7635E-27	3.0186E-19	7.1772E-28
2600	5.0902E-05	1.8622E-04	3.9739E-03	1.1795E-27	3.4577E-24	1.5193E-18	3.1661E-25
2800	1.7477E-04	5.6803E-04	1.0880E-02	3.6136E-25	7.2120E-22	6.0394E-18	5.7959E-23
3000	4.7909E-04	1.4054E-03	2.4511E-02	5.0122E-23	7.1685E-20	1.8887E-17	5.1335E-21
3200	1.1729E-03	3.1454E-03	5.0540E-02	3.7869E-21	4.0461E-18	5.2107E-17	2.6183E-19
3400	2.5206E-03	6.2453E-03	9.3346E-02	1.7071E-19	1.4102E-16	1.2489E-16	8.3645E-18
3600	4.8541E-03	1.1210E-02	1.5711E-01	5.0157E-18	3.2964E-15	2.6586E-16	1.8186E-16
3800	8.5091E-03	1.8451E-02	2.4415E-01	1.0295E-16	5.5138E-14	5.1127E-16	2.8727E-15
4000	1.3733E-02	2.8139E-02	3.5355E-01	1.5603E-15	6.9516E-13	8.9924E-16	3.4756E-14
4200	2.0582E-02	4.0065E-02	4.8036E-01	1.8249E-14	6.8823E-12	1.4602E-15	3.3555E-13
4400	2.8689E-02	5.3302E-02	6.1244E-01	1.7052E-13	5.5269E-11	2.1940E-15	2.6747E-12
4600	3.7444E-02	6.6670E-02	7.3682E-01	1.3092E-12	3.6954E-10	3.0727E-15	1.8029E-11
4800	4.5581E-02	7.8054E-02	8.3243E-01	8.4566E-12	2.1028E-09	3.9974E-15	1.0538E-10
5000	5.2077E-02	8.6034E-02	8.8794E-01	4.6876E-11	1.0373E-08	4.8631E-15	5.4303E-10
5200	5.6563E-02	9.0401E-02	9.0519E-01	2.2667E-10	4.5039E-08	5.6058E-15	2.4900E-09
5400	5.7923E-02	8.9777E-02	8.7410E-01	9.6983E-10	1.7442E-07	6.0744E-15	1.0343E-08
5600	5.6664E-02	8.5361E-02	8.0975E-01	3.7134E-09	6.0878E-07	6.2710E-15	3.9068E-08
5800	5.2774E-02	7.7419E-02	7.1684E-01	1.2848E-08	1.9325E-06	6.1481E-15	1.3559E-07
6000	4.8052E-02	6.8770E-02	6.2251E-01	4.0471E-08	5.6166E-06	5.8797E-15	4.2902E-07
6200	4.2597E-02	5.9567E-02	5.2792E-01	1.1682E-07	1.5038E-05	5.4630E-15	1.2465E-06
6400	3.6951E-02	5.0562E-02	4.3932E-01	3.1069E-07	3.7268E-05	4.9574E-15	3.3294E-06
6600	3.1215E-02	4.1851E-02	3.5692E-01	7.6491E-07	8.5871E-05	4.3733E-15	8.2217E-06
6800	2.6361E-02	3.4672E-02	2.9055E-01	1.7500E-06	1.8458E-04	3.8503E-15	1.8564E-05
7000	2.2156E-02	2.8619E-02	2.3589E-01	3.7370E-06	3.7165E-04	3.3684E-15	3.8572E-05

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13. ABSTRACT

Temperatures in the range of 2500 to 5000°K have been measured in the seeded air and nitrogen plasmas produced with the 2 megawatt arc heater at AEDC. Two spectral probes specially designed by the contractor were used for these measurements. Mass seed rates of potassium carbonate ranged from 0 to 1.88% by weight of potassium and power levels from 300 kw to 1000 kw. Temperatures determined from measured intensities of the continuous radiation and from atomic spectral lines of potassium were found in the seeded plasmas to agree satisfactorily with the static temperatures determined aerodynamically from an experimentally measured energy balance. Because of the strong dependence of intensity on temperature in the low range encountered, the observed intensity fluctuations in the jet resulted in less than a 10% change in temperature. Corrections of the seed lines for self-absorption brought the measured temperatures within 2% of those obtained from the continuum. The continuous radiation from unseeded air and nitrogen plasmas was measured to be about a factor of 15 higher than any existing theory predicts.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
potassium carbonate seed						
air						
nitrogen						
plasma jet						
diagnostics						
atmospheric pressure						
temperature measurement						
spectroscopy						
high current						
seed distribution program						
continuous radiation						
self-absorption						

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